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FAST BREEDER REACTOR PROGRAM

HEARINGS

BEFORE THE

JOINT ECONOMIC COMMITTEE
CONGRESS OF THE UNITED STATES

NINETY-FOURTH CONGRESS

FIRST SESSION

APRIL 30 AND MAY 8, 1975

Printed for the use of the Joint Economic Committee

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FAST BREEDER REACTOR PROGRAM

WEDNESDAY, APRIL 30, 1975

CONGRESS OF THE UNITED STATES,
JOINT ECONOMIC COMMITTEE,
Washington, D.C.

The committee met, pursuant to notice, at 10:35 a.m., in room 2154, Rayburn House Office Building, Hon. Hubert H. Humphrey (chairman of the committee) presiding.

Present: Senator Humphrey; and Representatives Bolling, Hamilton, and Brown of Ohio.

Also present: William A. Cox and George R. Tyler, professional staff members; Michael J. Runde, administrative assistant; Leslie J. Bander, minority economist; and George D. Krumbhaar, Jr., minority counsel.

OPENING STATEMENT OF CHAIRMAN HUMPHREY

Chairman HUMPHREY. We call to order the meeting of the Joint Economic Committee. Today our subject matter is the economics of the liquid metal fast breeder reactor. There will be subsequent hearings on this subject, but we want to get underway with Mr. Staats from the General Accounting Office and other witnesses.

Just a brief statement on my part. This major new nuclear reactor system called the breeder reactor will consume 450 million Federal dollars in fiscal year 1976, making it the largest single Federal energy program. I think it should be noted that the rate of spending on this project has quarupled since 1968. At the same time, due to numerous technological problems and, of course, inflation, the total program cost has risen to $10.7 billion from an original estimate of $2 billion. Progress has been halting and the programs' deadlines have slipped.

The benefits of the breeder are related to its role as a possible successor to our present generation of light-water nuclear reactors. There is little question that at some point, as we may deplete our uranium and fossil-fuel resources, a new technology for electricity generation must be found. The question is, however, whether the breeder is the right system for that purpose. Certainly alternative fuel sources such as solar energy and fusion now exist and are rapidly being developed. A secondary question is whether the breeder should be developed on what is commonly referred to as a "crash" basis or in a more protracted and orderly manner.

The General Accounting Office, represented here today by its Director, Mr. Elmer Staats, and the Environmental Protection Agency, represented by Mr. Sheldon Meyers, have raised questions regarding the breeder program. A GAO report issued Monday said that the present breeder program schedule is optimistic and possibly unrealistic. It noted that utility industry support for the breeder will depend upon factors not yet determined. In short, the private utilities are far from convinced now that the breeder will be safe or economical.

The Environmental Protection Agency's report is in the form of a critique of the breeder's environmental impact statement. The critique examined the major factors which bear on the level of benefits derived from the breeder—factors including in particular electricity demand and uranium supply.

In the case of the electricity demand, the EPA noted correctly that the rise in electricity prices has moderated the growth in electricity demand. Indeed, it is constraining demand enough so that the breeder program could be delayed from 4 to 12 years, according to the EPA, because of the reduced consumption of fossil and uranium fuels in the meantime.

Now, such a delay may be justified to determine what the actual benefits of the breeder program are; we could answer questions regarding safety, uranium supplies, the use of foreign breeder technology, the cost of solar and fusion energy, and other similar questions. I think it should be noted that this committee has not in any way passed judgment on these matters. These are matters to be explored. These hearings will be conducted to cross examine the different claims and counterclaims and hopefully to arrive at some conclusions and recommendations.

At the same time, just as I have noted, that delay could give to us a chance to reexamine certain parts of the program, delay also may mean higher program outlays as the breeder development program is stretched out. We have witnessed in so many endeavors that delay has resulted in a tremendous increase in the cost of the ultimate product.

It is my view that we will place heavy reliance on nuclear energy for electricity in the future. Now, whether that electricity can be produced most cheaply by breeder reactors is a question we hope to explore and shed some light on in these hearings.

We are very pleased to have with us today the Honorable Elmer Staats, Comptroller General of the United States. He will be followed by Mr. Sheldon Meyers of EPA and Mr. Theodore Taylor of the International Research and Technology Corp. We also have Mr. Phillip Hughes of the General Accounting Office with us today.

We are very fortunate to have the outstanding work and service that the GAO gives to the Congress, and I want to express publicly our appreciation for the superb research and evaluation that comes to us from the Comptroller General's office.

Before we hear from you, Mr. Staats, I ask that your General Accounting Office report, entitled "The Breeder Reactor Program—Past, Present, and Future" be included in the record of this hearing.

[The report follows:]

REPORT TO THE CONGRESS

The Liquid Metal Fast Breeder Reactor Program--Past, Present, And Future

Energy Research and Development Administration

BY THE COMPTROLLER GENERAL OF THE UNITED STATES

RED-75-352

APRIL 28, 1975

COMPTROLLER GENERAL OF THE UNITED STATES
WASHINGTON, D.C. 20548

B-164105

To the President of the Senate and the
Speaker of the House of Representatives

This is our report on the liquid metal fast breeder reactor program--past, present, and future.

We made our review pursuant to the Budget and Accounting Act, 1921 (31 U.S.C. 53), and the Accounting and Auditing Act of 1950 (31 U.S.C. 67).

We are sending copies of this report to the Director, Office of Management and Budget, and the Administrator, Energy Research and Development Administration.

Elmer B. Staats

Comptroller General
of the United States

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ABBREVIATIONS

AEC	Atomic Energy Commission
CRBR	Clinch River Breeder Reactor
EBR	Experimental Breeder Reactor
ERDA	Energy Research and Development Administration
FFTF	Fast Flux Test Facility
GAO	General Accounting Office
LMFBR	Liquid Metal Fast Breeder Reactor
NCBR	Near Commercial Breeder Reactor
R&D	Research and Development
RRD	Reactor Research and Development Division

COMPTROLLER GENERAL'S
REPORT TO THE CONGRESS

THE LIQUID METAL FAST BREEDER
REACTOR PROGRAM--PAST, PRESENT,
AND FUTURE
Energy Research and Development
Administration

D I G E S T

WHY THE REVIEW WAS MADE

The liquid metal fast breeder reactor is our Nation's highest priority energy program. A breeder reactor can create for the future more fuel than it uses.

Because of the intense congressional and public interest in this breeder and the very large amounts of Government and private funds that have been and are expected to be spent to develop it, GAO wanted to know how the breeder program started, where it is today, and where it is going.

GAO will release shortly a report on the cost and schedule estimates for the first breeder demonstration plant, and an issue paper on the broad range of promises and uncertainties of the total breeder program.

FINDINGS AND CONCLUSIONS

The Energy Research and Development Administration (ERDA)--the successor agency to the recently abolished Atomic Energy Commission (AEC)--envisions that operation of the first large commercial breeder will begin in 1987--a target date which has slipped 3 years since 1969. ERDA expects to subsidize this first commercial plant. ERDA projects that by the year 2000, 186 commercial-size breeders will be built and operating, some of which might also require subsidies. However, there are indications that these ERDA projections are optimistic. (See pp. 2 to 4.)

ERDA's approach to commercializing breeders includes building a demonstration plant to show that a breeder can operate safely, cleanly, and reliably. Plans to build the Nation's first breeder demonstration plant are now in the preliminary design stage. (See p. 7.)

Until recently, the breeder program stressed the progressive development of six successively larger demonstration plants. This approach would have required considerable Government support to develop larger components for each successive demonstration plant. In mid-1974, AEC realized that this approach placed too much emphasis on plant construction and operation and not enough on developing plant components.

Consequently, AEC terminated plans for all but one demonstration plant and decided to build instead a facility to test large components. This major redirection places the single demonstration plant in a very important position. (See pp. 8 and 9.)

AEC's total breeder program funding through fiscal year 1974 was about $1.8 billion. Recent estimates show that an additional $8.9 billion (fiscal year 1975 and 1976 dollars) will be needed to carry the program through to 2020. Since 1968 the expected costs of the program have increased by $6.8 billion, $3.5 billion of which ERDA attributes to inflation. (See pp. 9 to 11.)

Tear Sheet. Upon removal, the report cover date should be noted hereon.

The recent cost estimate includes $300 million for Government subsidy of one plant after the demonstration plant. This cost estimate assumes that major design and construction improvements would be realized after the demonstration plant.

ERDA officials told GAO that based on other analyses ERDA and its contractors have made, the subsidy could be as high as $2 billion for several plants if the program does not attain its development goals and resulting improvements and if more conservative assumptions are made. (See p. 11.)

In addition to Federal funding of the breeder, over half a billion dollars of private funds have been or will be spent over the next 5 to 10 years to develop the breeder and build the demonstration plant. (See pp. 11 and 12.)

Elements and facilities making up the breeder program

The overall breeder program consists of six major program areas, each of which contributes an important element of technology. Within the fuels and materials area, there is a potential problem concerning the continued availability of qualified commercial fabricators of breeder fuel. (See pp. 15 to 18.)

The fuel recycle area is probably the least technologically advanced area at this time. The ability to recycle plutonium for use in the breeder is essential to the breeder concept. The Nuclear Regulatory Commission is presently considering the question of allowing recycling of plutonium in light-water reactors. The Commission's decision, expected in late 1977 or early 1978, could have an adverse effect on the breeder program. (See pp. 18 and 19.)

Each area has at least one major test facility. GAO identified 22 major facilities in use or being built in support of the program. ERDA plans to build eight more major facilities. The estimated cost of all these facilities is about $3 billion, which is included in the breeder program cost estimate. (See pp. 15 and 24.)

Three of the most important facilities have experienced substantial cost increases and schedule delays.

For example, a facility to test breeder fuels was originally estimated in 1967 to cost $87.5 million to construct and was to begin operations early in 1974. This test facility is now forecast to cost $512 million and operations are expected to begin early in 1980. The other two facilities have also experienced cost increases of over 100 percent as well as schedule delays. (See pp. 25 and 26.)

Management of ERDA's breeder program

The ERDA division that manages the breeder program had been experiencing delays in reaching agreement on programmatic and technical matters affecting the program and needed to keep top management better informed of problem areas. The division recognized these problems and contracted with a private consulting firm to identify ways to improve management control.

As a result, the division is implementing a new system for administering, managing, and controlling its various programs, of which the breeder is the most important. This system is intended to provide increased program visibility and control.

If properly implemented, the new system should reasonably assure that ERDA will have greater visibility over the LMFBR program and that it will be in a position to better focus management attention and direction over those areas of the program experiencing problems. (See pp. 27 to 31.)

The demonstration plant project, the Clinch River Breeder Reactor, is managed jointly by ERDA and utility industry participants. This management arrangement is complex and potentially cumbersome. Project officials say no problems have resulted thus far from this complex arrangement because of the compatible personalities of the two individuals most directly involved in managing the project. (See pp. 31 and 32.)

In GAO's view, the organizational arrangement for the demonstration plant project, which depends heavily upon the personalities of the individuals involved, may prove to be so cumbersome as to hinder the effective management of the design and construction of the Clinch River Breeder Reactor and consequently represents a potential risk to the project. An ERDA review group reached similar conclusions.

The breeder demonstration project is now estimated to cost the Government about $1.468 billion--$1 billion more than was estimated several years ago. GAO believes that now, when the Government is expected to commit an additional $1 billion to the project, may be an appropriate time to seek a change in the present contractual arrangement to strengthen and steamline Government control over the project. (See p. 32.)

On March 10, 1975, ERDA submitted to the Joint Committee on Atomic Energy for its approval proposed legislation and underlying documents that would provide for a new management structure for the project. Essentially, management control of the project would be given to ERDA, commensurate with the Government's investment in the project. This new management structure is intended to strengthen and streamline Government control over the project.

In a recent report, GAO pointed out that the various documents ERDA submitted to the Joint Committee did not clearly delineate the manner in which the project would be managed and that ERDA might not be able to exercise usual management prerogatives. (See p. 32.)

Relation to breeder funding to total Federal energy funding

Federal energy research and development funding has grown markedly since fiscal year 1971 when it was $420 million. The proposed fiscal year 1976 Federal budget includes $1.8 billion for energy research and development. (See pp. 33 and 34.)

Federal funding for developing the breeder was $168 million in fiscal year 1971, representing 40 percent of total Federal energy research and development funding. In fiscal year 1976, funding for the breeder is estimated to be $474 million, about 26 percent of total Federal energy research and development funding. (See p. 35.)

Foreign breeder programs

Developing a liquid metal fast

breeder is a high priority national energy program of five other major industrial nations: United Kingdom, France, Japan, West Germany, and the Soviet Union. ERDA says that, of the foreign programs, those of the Soviet Union and France are probably the most advanced in reactor development. (See pp. 36 to 39.)

Although there are some differences between the U.S. and foreign programs, all foreign programs either contain or plan many of the same elements that are in the long-range U.S. program. (See p. 40.)

A contributing factor in the rapid advance of the French program, ERDA says, has been the less stringent safety requirements in France. ERDA says that French breeder reactors would have a difficult time getting licensed in the United States, although the licenseability of French reactors has not been explored in the United States. (See pp. 40 to 42.)

An ERDA review group report said foreign breeder programs can contribute important data and information to the U.S. program. The U.S. program could make use of foreign programs under several specific arrangements; however, none of these arrangements could save any large amount of U.S. effort. (See p. 42.)

RECOMMENDATIONS AND SUGGESTIONS

This report contains no recommendations.

AGENCY ACTIONS AND UNRESOLVED ISSUES

GAO discussed this report with ERDA officials on several occasions and believes that there are no major residual differences in fact.

MATTERS FOR CONSIDERATION BY THE CONGRESS

If the Congress wants to know whether greater reliance can be placed on the use of foreign liquid metal fast breeder reactor technology, it should explore with ERDA in greater depth the advantages and disadvantages of using foreign liquid metal fast breeder reactor technology.

CHAPTER 1

THE LIQUID METAL FAST BREEDER REACTOR PROGRAM--ORIGIN AND EVOLUTION

A breeder reactor, such as the Liquid Metal Fast Breeder Reactor (LMFBR)[1], can create more fuel than it uses. Because of this feature, developing a commercial LMFBR is the aim of the Nation's highest priority energy program. Efforts to develop the LMFBR concept have cost the Federal Government about $1.8 billion. The Energy Research and Development Administration (ERDA)[2]--successor agency to the Atomic Energy Commission (AEC)--projects that it will cost an additional $8.9 billion through the year 2020.

WHY AND WHEN IS LMFBR EXPECTED TO BE NEEDED

The growing shortage of fossil fuels is spurring the search for alternate sources of energy. Nuclear power reactors, using enriched uranium as a fuel, are an alternative to fossil fuels for generating electricity. ERDA predicts that the U.S. electrical energy demand will double between 1970 and 1985 and will double again by the year 2000. Nuclear power presently accounts for about 6 percent of the total U.S. electrical generating capacity. ERDA expects nuclear power will account for about 60 percent by the year 2000.

Currently, 53 commercial nuclear power plants are operating in the United States. One is a high temperature gas-cooled reactor and the rest are light-water cooled reactors. All of the currently operating nuclear reactors consume fuel during the energy producing process. Because of the limited supply of low-cost uranium ore available for fuel in such

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[1]Liquid metal refers to the liquid sodium used as the coolant to carry off the heat of the reactor fuel. A fast reactor is a reactor in which the chain reaction is sustained primarily by fast neutrons rather than by the slower speed neutrons found in present generation commercial nuclear power reactors.

[2]The Energy Reorganization Act of 1974 (Public Law 93-438) abolished AEC and established the Energy Research and Development Administration and the Nuclear Regulatory Commission on January 19, 1975. All of the AEC programs and activities discussed in this report are now carried out by the Energy Research and Development Administration and the Nuclear Regulatory Commission.

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reactors, ERDA has expressed the belief that the full potential of nuclear energy for the future can be realized only by developing the breeder reactor because (1) the known economically recoverable domestic uranium reserves (approximately 700,000 tons) will be committed to light-water reactors within a few years and (2) complete reliance on light-water reactors will deplete these estimated reserves in about 25 to 50 years.

Light-water reactors use only about 2 percent of the energy available in the nuclear fuel they use. Fast breeder reactors, on the other hand, can use as much as 60 percent or more of the total energy from the nuclear fuel and, at the same time, create more fuel for future use than they use.

ERDA is developing several types of breeder reactors: (1) the molten salt breeder, (2) the light-water breeder, (3) the gas-cooled fast breeder, and (4) the LMFBR. The LMFBR has been the highest priority breeder program since the mid-1960s.

Program schedule

The present LMFBR program schedule calls for commercial introduction of the LMFBR in 1987. ERDA defines commercial introduction as that point in time that one large-scale breeder reactor becomes operational. ERDA recognizes that this reactor would not be of the same power level as later reactors and that it would require some form of Government subsidy. In addition, under the present plan, ERDA is projecting that 8 breeder reactors would be built in the late 1980s and large numbers would be built in the early 1990s. Some of these reactors may require additional Government subsidies.

ERDA officials emphasized, however, that ERDA's Administrator is still formulating plans for the LMFBR and, as of March 1975, he had not reached a final position on the program.

ERDA anticipates that during the early 1990s a viable and competitive commercial industry can be developed. A viable industry will include reactor manufacturers and architect-engineers from whom interested utilities can solicit bids and select a power plant. A competitive industry will include a number of qualified and experienced vendors from whom selections can be made for furnishing major equipment items.

AEC projected that, by the year 2000, 186 commercial-size LMFBRs will be built and operating. These projections were derived from a cost-benefit analysis contained in the Proposed Final Environmental Statement on the LMFBR program, which AEC released for public comment in January 1975. The following chart shows the number of LMFBRs expected to begin operations through the year 2019.

Year	Number of plants that begin operations	Cumulative number of plants built
1986-87	1	1
1988-89	8	9
1990-91	13	22
1992-93	24	46
1994-95	34	80
1996-97	46	126
1998-99	60	186
2000-19	992	1,178

The Proposed Final Environmental Statement points out, however, that general schedule slippages in U.S. utilities' plans for added electrical generating capacity

> "* * * suggests that the assumed timing of commercial breeder introduction should also be slipped, presumably into the early 1990s, instead of the late 1980s as previously assumed."

Our discussions with representatives of the utility industry and reactor equipment manufacturers indicate that ERDA's projections for the number of LMFBRs in the late 1980s and early 1990s is optimistic and possibly unrealistic. These representatives expressed the view that few utilities would be willing to commit large amounts of capital until they were fairly certain that LMFBRs would be technically and economically viable.

Building reactors in the United States from time of commitment to operation presently requires about 8 to 10 years. To meet ERDA's projections, utilities would be required to commit large amounts of capital in the late 1970s or early 1980s--which is at least several years before ERDA expects to have developed and tested the major components required for commercial-size LMFBRs. It is also up to 10 years prior to the expected 1987 operation of the first commercial-size LMFBR, which ERDA believes will confirm the economic viability of commercial-size LMFBRs.

In a 1969 cost-benefit study of the breeder program, LMFBR's introduction date was predicted to be 1984, 3 years earlier than the present schedule. AEC attributed this 3-year schedule slip to (1) delays in negotiating contracts for and getting congressional authorization for the LMFBR demonstration plant project (Clinch River Breeder Reactor) and (2) such external factors as delays in light-water reactor licensing and the court-imposed requirement to issue an environmental impact statement on the overall LMFBR program.

In October 1974, AEC requested that a special staff study be made of the LMFBR program. In part, the review was to reassess the need for and timing of the LMFBR in light of the latest available information. The review group concluded that, because of the limited amount of known economically recoverable domestic uranium reserves, LMFBR's development is needed to insure the continued availability of the nuclear power option to meet the Nation's future energy needs. The group recommended that the LMFBR program should proceed expeditiously toward the goal of a commercial breeder by the early 1990s. They also recommended that an aggressive, accelerated effort be undertaken to better define the likely availability and producibility of economic uranium resources in the United States. The group said that the LMFBR program should be reassessed as additional resource data becomes available.

HOW DID LMFBR EVOLVE TO ITS CURRENT STATUS?

Interest in fast breeder reactors dates back to the early 1940s. Nuclear scientist Enrico Fermi first demonstrated the concept in experiments at the University of Chicago. His experiments produced the first apparent evidence that breeding nuclear fuel was possible. The reactor used in these experiments was the first facility to successfully show a self-sustaining nuclear chain reaction on December 2, 1942. The phenomenon opened the doors to the development of the nuclear power industry.

Because expert atomic scientists and uranium resources were devoted to developing the atomic bomb for use in World War II, the national laboratories were not able to devote full attention to the breeder reactor. After the war, the nuclear scientific community increased its effort toward breeder reactor development. AEC was formed in 1946 to develop and manage atomic energy activities in the United States.

At first, AEC considered various breeder programs. The Clementine reactor at Los Alamos Scientific Laboratory in New Mexico was one of the earliest steps towards the advancement of the breeder concept. It operated from 1946 to 1953 and was used to explore the possibilities of operating a fast reactor with plutonium fuel and a liquid metal (mercury) as a coolant. This first experimental reactor proved that fast reactors could operate safely and reliably.

The next significant event was the construction and operation of the Experimental Breeder Reactor I (EBR-I) by Argonne National Laboratory at its test site in Idaho. On December 20, 1951, this facility produced the world's first electricity from nuclear fuel. EBR-I proved the feasibility of the breeding concept.

During the operation of EBR-I, the next significant step occurred--the design and construction of Experimental Breeder Reactor II (EBR-II) by Argonne National Laboratory at its Idaho test site. Construction of this facility began in 1958 and operations began in 1963. EBR-II was to determine the feasibility of (1) using a fast reactor with a sodium coolant as a central station plant and (2) developing a fuel recycle capability for reprocessing used (or spent) fuel from the reactor to remove certain radioactive products, refabricating the fuel into new fuel, and placing it back in the reactor for continuing operations. In 1965, EBR-II's primary purpose was changed to its present role--to testing fuels and materials for the LMFBR program. EBR-II is the only operating breeder reactor in the United States.

In early 1955, AEC invited proposals from private industry to design, construct, and operate a power reactor as part of AEC's 5-year reactor development program. Construction of this reactor--called the Enrico Fermi Atomic Power Plant--began in 1956 and critical operations began in 1963. This was the Nation's first privately owned and operated fast breeder reactor; however, AEC provided some financial assistance to industry for this project. The plant operated until late 1972 and produced 32,000 megawatt[1] hours of commercial electricity.

The development of LMFBR technology through the early and mid-1960s resulted in identifying certain problem areas needing resolution. To find solutions to the problems, various facilities were or are being built, including the: (1) Los Alamos Molten Plutonium Experiment, (2) Southwest Experimental Fast Oxide Reactor, and (3) Fast Flux Test Facility (FFTF). All three were or are special purpose reactors built for specific types of experiments. For example, the Southwest Experimental Fast Oxide Reactor was designed to demonstrate inherent safety characteristics of a particular type of LMFBR fuel. Other special purpose facilities--the Nuclear Instrument Test Facility and the Radioactive Sodium Chemistry Loop--which supported LMFBR were also built at this time.

In 1967, AEC issued a report to the President which described the breeder's promise of meeting the Nation's long-

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[1]A unit of power; equal to 1,000,000 watts.

term energy needs and established the LMFBR program as its highest priority civilian reactor development effort. LMFBR was chosen over other breeder concepts because of (1) its potential favorable performance and economy, (2) interest and support by reactor manufacturers and electric utilities, (3) the amount of base technology and operating experience already available, and (4) proven basic feasibility. AEC stated that these factors provided the basis for LMFBRs to realize a relatively short development-to-commercialization time period.

From 1965 to 1967, the electric utility industry started making large scale commitments to rely on nuclear power plants for much of the additional electrical capability our country needed. These commitments involved primarily constructing and operating light-water reactor power plants.

The increased electrical consumption during the late 1960s and early 1970s resulted in brownouts in major cities across the country. Fossil fuel prices rose sharply and some major utilities' levels of existing fuel reserves decreased. As a result, the President directed that a special review of the national energy situation be made. This review was to identify possible approaches the Federal Government could take to alleviate the potential shortages of fuel and to help insure that enough fuel existed for future use.

The results of the review were reflected in the President's Energy Message to the Congress in June 1971. In this message, the President established the LMFBR program as the Nation's highest priority energy program and made a national commitment to successfully demonstrate the concept by 1980. According to AEC, the national priority placed on developing LMFBR was needed to take full advantage of the momentum and technical progress achieved up to that time and to get the funding required to demonstrate the concept.

In 1973, the President reemphasized the national energy supply problem and established Project Independence. The current objective of Project Independence is to achieve invulnerability to changes in foreign production and shipment of energy supplies. This places even more importance on developing new energy sources, like LMFBR.

THE APPROACH TO COMMERCIALIZATION OF LMFBR

The basic objective of the LMFBR program is to develop a broad technological and engineering base with extensive utility and industrial involvement which will lead to a strong, competitive, commercial breeder industry. The long-term goal for the program is to establish a breeder reactor economy early in the 21st century which will furnish all the material needed to fuel nuclear plants to meet our total electrical energy demand.

AEC's approach to the commercialization of LMFBRs has been proceeding along two lines of effort--the base technology program and the demonstration plant program. Under the base technology program, emphasis is placed on developing key technical areas. Engineering development, manufacturing, and proof testing efforts have been and are being expanded within this part of the program. These efforts are performed with private industry and are directed at developing realistic technical and economic bases for the LMFBR demonstration program.

The demonstration plant program is to serve as the key to the program's transition from the technology development phase to large-scale commercial utilization. Plans for building the Nation's first LMFBR demonstration plant--the Clinch River Breeder Reactor (CRBR) near Oak Ridge, Tennessee--are now in the preliminary design stages. This facility is to be a 350 megawatt electric (MWe)[1] powerplant and is presently scheduled to be operational by mid-1982. It is a cooperative government/industry effort. CRBR's primary objectives are to

--demonstrate the safe, clean, and reliable operation of an LMFBR closely resembling a commercial-sized plant while showing a high availability factor for power production in a utility environment,

--serve as the focal point for the development of systems and components,

--develop industrial and utility capabilities to design, construct, and operate LMFBRs, and

--demonstrate the commercial licenseability of LMFBRs.

According to AEC, constructing and operating an LMFBR demonstration plant is the only means by which these objectives can be realized. The guidelines issued in establishing CRBR as it presently exists were based on utility recommendations.

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[1]A megawatt electric is a measure of electric power while a megawatt thermal (MWt) is a measure of heat. For present generation nuclear powerplants, about 3 MWt are required for each MWe produced.

AEC considered other approaches to realizing these same objectives, including trying to encourage industry to undertake the demonstration of LMFBR technology on its own, relying on foreign experience to demonstrate the concept, and purchasing foreign LMFBR technology and adopting it to the prevailing U.S. regulatory requirements. AEC pointed out, however, that none of the alternatives was able to meet the objectives satisfactorily.

Until mid-1974, AEC had stressed the progressive development of successively larger demonstration and "early commercial" plants,[1] using these plants as test beds for component development. AEC projected that two more demonstration plants and three early commercial plants would be built after CRBR. These plants were expected to show the reliability, safety, licenseability, and environmental acceptability of the LMFBR concept and would provide private industry with a reliable basis on which to build an LMFBR energy economy. This approach would require considerable Government support for developing larger sodium components, such as steam generators, pumps, valves, piping, and heat exchangers for each successive demonstration plant.

As a result of an assessment of the LMFBR program made in mid-1974, AEC--along with industry, AEC national laboratories, and utility executives--identified a severe program imbalance. AEC realized that building a number of successively larger demonstration plants placed too much emphasis on developing plant components for each successive plant. This approach would have required development of several generations of large components--a costly and time consuming process. ERDA officials believe that component development concurrent with plant construction has been a probable cause of the delays experienced thus far in the construction of FFTF and that this approach could delay construction of CRBR.

Consequently, in July 1974, AEC made a major redirection to its LMFBR program. The redirection called for terminating plans for multiple demonstration plants and going with only a single demonstration plant--CRBR. Instead of follow-on demonstration and early commercial plants, a large component test facility--Plant Component Test Facility--is now planned to test full commercial-size sodium components. Early plant experience is expected to be gained by operating FFTF and CRBR in the United States as well as from foreign

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[1]Operating LMFBR plants smaller in size and power generating capacity than future commercial LMFBR plants are anticipated to be.

LMFBR programs. One near commercial plant[1] is planned to cover any further needs in the plant experience area. It is expected to be about 1,000 to 1,500 MWe in size and to consist of the large commercial-size components to be developed and tested under the component development portion of the LMFBR program.

With this revised program, CRBR is placed in an even more important position; it will now be depended upon to demonstrate the reliability, safety, licenseability, and environmental acceptability of the LMFBR concept. Also, CRBR will serve as a focal point for developing components and systems. In this capacity it should provide major input to the large component development programs and the testing requirements which must be factored into the design of the Plant Component Test Facility. This facility is planned to become operational in the early 1980s.

According to ERDA, the availability of the Plant Component Test Facility should allow industry to construct large commercial-size components much sooner than previously contemplated. ERDA has stated that this adjusted LMFBR plan should further enhance the ability of industry to design and build a number of large commercial plants for operation by the late 1980s or early 1990s.

HOW MUCH WILL IT COST TO DEVELOP LMFBR?

AEC's total LMFBR program funding from fiscal year 1948 through fiscal year 1974 was about $1.8 billion. ERDA recently estimated that an additional $8.9 billion (fiscal year 1975 and 1976 dollars--effects of inflation for fiscal years after 1976 are not included) will be needed to carry the program through to 2020--making a total program cost of $10.7 billion. The following chart summarizes the LMFBR costs through fiscal year 1974 and projections through fiscal year 2020. A more detailed chart showing projected program costs for fiscal years 1975 to 2020 is included in appendix I.

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[1]One which has full-size commercial plant components and features; it may be at a lower power level than a commercial plant.

LMFBR Program Summary

	Thru FY 74 (actual)	FY 75 (FY 75 dollars)	FY 75 to 2020 (FY 75-76 dollars)	Total
	---------(millions of dollars)-------			
Operating				
Reactor physics	$ 119	$ 11	$ 162	$ 281
Fuels and materials	619	114	1,816	2,435
Fuel recycle	15	6	507	522
Safety	97	36	1,023	1,120
Components	470	88	2,021	2,491
Plant experience	30	56	1,489	1,519
Subtotal	1,350	311	7,018	8,368
Capital equipment	66	23	424	490
Construction	379	147	1,431	1,810
Total	$1,795	$481	$8,873	$10,668

In a 1969 AEC study entitled "Cost-Benefit Analysis of the U.S. Breeder Program," AEC projected for the first time the expected research and development costs for the LMFBR program. The costs through 2020 were estimated to be about $3.9 billion. Thus, since 1968, the expected costs of the LMFBR program have increased by about $6.8 billion, nearly a threefold increase.

Based on a recent ERDA study comparing the two estimates, $3.5 billion of the $6.8 billion increase was due to inflation through fiscal year 1976. The remaining $3.3 billion increase was due to changes in the scope of the program, including increased costs associated with the FFTF project ($660 million), CRBR project ($670 million), increased large component development program ($1,120 million), fuel development program ($450 million), and safety program ($140 million), and capital equipment and miscellaneous ($220 million).

These cost estimates do not include the amounts spent by AEC's regulatory organization or the amounts to be spent by the successor agency--the Nuclear Regulatory Commission--to meet their licensing and related responsibilities pertaining to the LMFBR program. AEC's regulatory organization spent about $2.2 million in fiscal year 1973 and 1974 and the Nuclear Regulatory Commission expects to spend $22.7 million during fiscal years 1975 through 1980 on LMFBR related work.

The costs for program direction and administration by ERDA employees are not included in the LMFBR program cost estimate. ERDA does not charge any of its research programs, including the LMFBR, with regulatory costs or with the costs of directing and administering programs by its employees. This treatment is consistent with ERDA's budget justification to the Congress, where program direction and administration costs are also considered separately rather than allocated to other programs and activities. However, administrative costs of contractors engaged in the LMFBR program are included in the costs of that program.

A major question that could significantly increase the projected LMFBR program cost involves the number of LMFBR plants needed after CRBR for the LMFBR total power costs to become competitive with light-water reactor costs. AEC's LMFBR program cost estimate includes $300 million for a Government subsidy of one plant after CRBR. ERDA officials said, however, that there is a great deal of uncertainty regarding (1) the amount of subsidy that will be necessary for the first plant after CRBR and (2) whether subsidies will be necessary for additional plants. The officials explained that much of this uncertainty stems from whether design and construction improvements can be realized after CRBR. The estimate that only one plant after CRBR would require a subsidy of $300 million is based on the assumption that such design and construction improvements would be significant.

ERDA officials told us that based on other analyses ERDA and its contractors have made, this amount could be as high as $2 billion for several plants if the program does not attain its development goals and resulting improvements and if more conservative assumptions are made.

Cost of privately funded research and development

In addition to AEC-ERDA funding, a considerable amount of privately funded research and development effort is devoted to the LMFBR program. Reactor manufacturers, such as Atomics International, a Division of Rockwell International; Babcock and Wilcox; Combustion Engineering, Inc.; General Electric Company; and Westinghouse Electric Corporation have spent more than $80 million for privately funded research and development on LMFBR through 1974. According to company representatives, these companies expect to spend more than $225 million over the next 5 years (1975 through 1979).

The electric utility industry is also contributing to the LMFBR program. As of February 1975, more than 700 electric utilities and cooperatives have pledged $257 million to support CRBR. This represents the largest single commitment to a research and development project ever undertaken by the electric utility industry.

WHO IS INVOLVED IN THE LMFBR PROGRAM?

Carrying out the LMFBR program involves many varied participants from Federally owned, contractor-operated laboratories to private industrial firms and universities. As of September 1974, 49 AEC prime contractors and major subcontractors were participating in the LMFBR program. Fiscal year 1974 staffing data illustrate the amount of resources that have been used in the program. In that year, 2,693 direct professional staff-years of effort were spent by AEC laboratory and contractor personnel. This amounts to 79 percent of the total 3,413 direct professional staff-years spent at these same locations to support AEC's civilian reactor development program, which includes the LMFBR program. Appendix II shows the major program participants by LMFBR program area.

National laboratories and engineering centers

ERDA oversees a number of Government-owned laboratories that are operated by contractor organizations representing universities, other nonprofit organizations, and private industry. There are 32 such facilities throughout the country, excluding production and nuclear weapons fabrication facilities. These laboratories have built up a diversity of scientific and technical resources and plant facilities.

Major ERDA Laboratories and Engineering Centers and Their Major Areas of Responsibilities in Support of the LMFBR Program

ERDA facility and location	Area of responsibility
1. Argonne National Laboratory, Chicago, Illinois	Fuels and materials, physics and safety research, and component engineering activities
2. Hanford Engineering Development Laboratory, Richland, Washington	Fuels and materials and core development activities
3. Liquid Metal Engineering Center, Santa Susana, California	Component and instrumentation development

4. Holifield National Laboratory, Oak Ridge, Tennessee — Safety, fuel recycle, and component development

Argonne National Laboratory, which devotes a major portion of its effort to the LMFBR program, has the only operating breeder reactor in the United States--EBR-II. Although Argonne is primarily responsible for LMFBR safety programs, it also carries out basic studies and applied technology work in the fields of reactor physics, fuel and materials development, and component engineering.

Hanford Engineering Development Laboratory is the site of the key engineering development laboratory for the LMFBR program. Its initial mission is to manage the development, design, construction, and startup of FFTF, which it will then operate. This laboratory is largely responsible for examining, developing, and fabricating fuels, materials, and cladding; for developing reactor component and instrumentation and sodium technology; and for materials management and safeguards.

The Liquid Metal Engineering Center is a complex of liquid sodium facilities for testing and evaluating components such as heat exchanges, steam generators, valves, piping, pumps, flowmeters, and other mechanical elements for breeder reactors.

Although Holifield National Laboratory is involved in all LMFBR program areas except plant experience, it is primarily involved in the safety program and the development of LMFBR design and engineering standards. Remote handling operations for LMFBR fuel and structural design methods are two other essential elements of its program.

Other ERDA laboratories also participate in the development of LMFBR, but to a lesser extent. Some of these are the Los Alamos Scientific Laboratory at Los Alamos, New Mexico; the Pacific Northwest Laboratory at Richland, Washington; and the Idaho National Engineering Laboratory at Idaho Falls, Idaho.

<u>Private industry</u>

Private industry's involvement in the developmental stages of the LMFBR program is essential for meeting the program objective of establishing a timely capability for a commercially competitive breeder program. Construction activities undertaken as part of the LMFBR testing and technology development program (e.g., Sodium Pump Test Facility, FFTF, High Temperature Sodium Facility) have provided the industrial sector of the nuclear community with large-scale involvement with LMFBR technology. Various private industrial firms, under contract to ERDA, do research and development work for the base LMFBR program.

Atomics International, a Division of Rockwell International, General Electric Company, and Westinghouse Electric Corporation are the chief industrial organizations involved in the program. All three are major participants on the CRBR demonstration project. Westinghouse is the lead reactor manufacturer responsible for integrating the entire nuclear portion of the plant. Atomics International and General Electric are heavily involved in the component development area of the base LMFBR program, and they also do some work in the safety and fuels and materials areas. Most of Westinghouse's effort for the base LMFBR technology program is in the component development and fuels and materials area. Westinghouse is also the FFTF reactor plant designer. Atomics International operates the Liquid Metal Engineering Center for ERDA.

The LMFBR program's high priority and the amount of money to be spent on it has generated a great deal of congressional and public interest in the program. The following chapters of this report discuss several aspects of LMFBR for which a great deal of interest has been expressed. These aspects are the

--elements and facilities making up the program,

--management structure of the program;

--relative funding emphasis of the LMFBR program, and

--LMFBR programs of foreign nations.

CHAPTER 2

ELEMENTS AND FACILITIES MAKING UP THE LMFBR PROGRAM

The LMFBR program consists of six major program areas, each of which contributes an important element of technology. To realize the overall objective of commercializing LMFBR, each area must be successfully completed. According to ERDA, none of these areas has been sufficiently developed to support a commercial plant at this time. The six areas are

--reactor physics,

--fuels and materials,

--fuel recycle,

--safety,

--component development, and

--plant experience.

Each program area has at least one major test or demonstration facility which provides a major contribution to the LMFBR commercialization objective. The relationship these facilities and program areas is shown in appendix III. For the most part, these are Government-owned and contractor-operated facilities. They have been built up over time and represent large capital investment by the Government. Many of the facilities are at the various national laboratories but some are at other contractor locations.

REACTOR PHYSICS

This program area's objective is to develop design data, experimental procedures, and analytical methods adequate to insure the safe and economic performance of commercial LMFBRs. The Zero Power Plutonium Reactor in Idaho is the principal experimental facility for this area. It is presently being modified so it will be able to handle experiments for reactor cores in the commercial size range. According to ERDA, this is the most technologically advanced area.

FUELS AND MATERIALS

This area is centered on developing a reliable, safe, and economic fuel system design. Efforts are being made to improve fuels and materials for near term needs and to develop advanced fuels and materials which are necessary if LMFBR is to reach its full potential for resource conservation and economic viability. A mixed-oxide[1] fuel design will be used as the initial fuel for FFTF and CRBR and could also be used in a commercial plant. But improved and advanced fuels and materials are being developed, primarily to increase the reactor's breeding capability.

EBR-II and its associated Hot Fuel Examination Facility are the primary facilities used in this area. When the FFTF is completed, it also will have a major role in carrying out experiments for developing fuels and materials. The FFTF will be the largest, highest performance fuel test facility in the world.

One additional facility (projected to cost $50 million) is planned for this area. It will be used to examine fuels and materials irradiated in FFTF and CRBR.

Uncertainty concerning the continued availability of qualified commercial fuel fabricators

In 1967, when LMFBR became AEC's highest priority reactor development program, AEC determined that a commercial LMFBR fuel fabrication capability within this country did not exist. Since it was essential to develop such capability, AEC undertook a multiphased program to develop an industrial capability to provide enough fuel to maintain the program.

As part of this effort, AEC awarded fixed-price contracts in 1972 to two companies to fabricate fuel for the first two FFTF reactor cores. These companies were already involved in nuclear fuel fabrication work for light-water reactors and had some experience with fabricating mixed-oxide fuel similar to that required for the LMFBR program. Based on current projections, both fabricators will complete production of the first two cores between June and August 1975. According to ERDA, the only other market for mixed-oxide fuel in the next several years will be the CRBR project. Fuel for CRBR will not have to be ordered until late 1978 to meet its schedule.

When the contract commitments for the first two FFTF cores are met, these fabricators will have no follow-on mixed-oxide fuel fabrication work and, according to ERDA, their current production facilities will probably be shut down. Whether these facilities could or would become operational again is uncertain. Thus there is a strong possibility that the capability (both facilities and personnel)

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[1]A mixed uranium and plutonium fuel.

of one or both fabricators will be lost to the LMFBR program. If the production capacity of these plants is lost and the plants are not available for further development, there is no assurance that the identified near-term fuel needs of both the FFTF and CRBR can be met.

Representatives of each contractor have indicated that if they could not maintain continued operations after their present commitments are met, they would have to close down their plants and would probably not reenter the field. They attributed this to the fact that if they shut down their present facilities they would be required to invest a substantial amount to capital to reenter the market. They would have to either extensively modify their existing facilities or build new plants to meet changing regulatory requirements and future technology changes.

One of the contractors already has indicated that, because of overall corporate interests, the company may decide not to participate beyond their current contractual requirements and may not reenter the mixed-oxide fuel fabrication market.

To maintain a capability in private industry to fabricate LMFBR fuel, a plan has been approved whereby ERDA will order two additional FFTF cores for future use. Only one of the two contractors is to be selected to produce the two additional FFTF cores. To select the contractor, ERDA plans to solicit bids by mid-calendar year 1975. The selected contractor would probably be asked to produce the CRBR project fuel when it is needed. ERDA anticipates that this approach will allow one contractor to continue operations until about mid-1978. If both contractors were selected to fabricate the additional FFTF fuel, ERDA estimates that there would only be enough work to carry both of them through the latter part of 1976. Thus, the possibility would still exist that both would be forced to shut down operations and the commercial production capability of their plants would be lost.

In following this one-supplier approach, ERDA is relying on the break in operations between completion of FFTF work and beginning of CRBR work to be short enough for the supplier to continue in the business. ERDA estimates this break to be about 6 to 12 months. According to an ERDA official, this break may be reduced by stretching out the FFTF fabrication work and/or beginning work on the CRBR fuel earlier than presently scheduled. However, the length of this break is directly related to the CRBR project meeting its scheduled

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July 1982 initial criticality[1] date. Since 1972, the initial criticality date of the CRBR project has been delayed for 3 years; from 1979 to 1982.

The course of action ERDA plans to take is directed at total support of one commercial mixed-oxide fuel fabricator for producing all of the near-term LMFBR fuel pins needed in the program. There are inherent problems with a situation wherein there is a total dependence upon one supplier. This could adversely effect such things as the future prices of needed fuel, incentive of one supplier to efficiently and effectively produce LMFBR fuel pins, and continued supply of fuel for LMFBR program needs.

In November 1974, AEC's Office of Planning and Analysis commented that this approach to support a sole commercial source was a departure from AEC's policy of developing competitive, free enterprise, commercial industries but that it may be justified because of the small expected near-term market for LMFBR fuel. However, this Office concluded that the basis for proceeding with this approach should be reexamined if there is significant CRBR project slippage.

FUEL RECYCLE

The objective of the fuel recycle program area is to develop technology in areas of reprocessing, refabricating, and shipping spent LMFBR fuels to permit an economically competitive LMFBR to attain a doubling time[2] of less than 10 years. The fuel recycle area is currently centered in the laboratory and, according to ERDA, it is probably the least technologically advanced area at this time.

The commercial success of the breeder depends on an efficient fuel cycle whereby fuel burned in the reactor can be reprocessed to recover the newly bred material (plutonium) as well as the remains of the spent material. This requires shipping the spent usable fuel, reprocessing it to recover any reusable material, and refabricating the recovered material into new LMFBR fuel. The efficiency of these processes will

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[1]The state of a nuclear reactor when it is sustaining a chain reaction.

[2]The time required for a breeder reactor to produce as much fissionable material as the amount usually contained in its core plus the amount tied up in its fuel cycle (fabrication, reprocessing, etc.). ERDA expects that later, with the perfection of advanced fuels, the doubling time for plutonium production in the breeders can be made to exceed the doubling time for electrical energy demand.

have a strong effect on fuel doubling time and hence economics of LMFBR. According to ERDA, LMFBR will not be viable without an efficient fuel cycle.

The ability to recycle plutonium for use in LMFBRs is essential to the LMFBR concept. The Nuclear Regulatory Commission is presently considering the question of allowing the recycling of plutonium in light-water reactors. In considering this question, the Commission is studying the issues surrounding the safety, environmental, and safeguard impacts of using plutonium. In August 1974, the AEC regulatory organization issued a draft on "Generic Environmental Statement on the Use of Recycled Plutonium in Mixed Oxide Fuel in Light Water-Cooled Reactors." A Commission official told us the Commission expects to reach a decision on the acceptability of recycling plutonium in light-water reactors in late 1977 or early 1978. This official said that a Commission decision, which does not approve plutonium recycling for light-water reactors for health, safety, or safeguard reasons, could have an adverse effect on the acceptability of recycling plutonium for the LMFBR since the health, safety, and safeguard impacts of using plutonium are similar for both.

The long-term goal for fuel fabrication is the startup of large commercial fuel fabrication facilities in 1988 or 1989. For fuel reprocessing, the goals are to commit funds for the first commercial reprocessing plant in 1987 and to start full-scale commercial fuel reprocessing by 1997.

To advance the fuel cycle to the potential of rapid reprocessing of fast reactor fuels, two facilities are planned: a High Performance Fuel Laboratory and an LMFBR Fuels Reprocessing Hot Pilot Plant. The High Performance Fuel Laboratory is projected to cost $54 million to build and is expected to become operational in late 1981 or early 1982. It will be used to demonstrate fabrication of LMFBR fuel using plutonium from light water reactors and will provide the technological base for designing and operating economic high production licenseable commercial plants.

The LMFBR Fuels Reprocessing Hot Pilot Plant, consisting of a storing and receiving facility and an experimental reprocessing plant, will demonstrate the technology of receiving, handling, storing, and reprocessing spent LMFBR fuel (initially FFTF and CRBR fuels) with full-scale equipment. The storing and receiving facility is presently estimated to cost $100 million and is expected to begin operating in mid-1981. The experimental reprocessing facility is estimated to cost $200 million and is expected to begin operating in fiscal year 1985.

SAFETY

The objective of the LMFBR safety program is to investigate and develop the technology necessary to resolve safety concerns related to the LMFBR concept. The program aims to develop sufficient technology to get a generally accepted view that LMFBRs do not represent an undue hazard to the health and safety of the public. The program is intended to demonstrate that

--accidents leading to major core disruption will not happen;

--even if accidents do happen, the system can be designed to preclude serious damage; and

--even if the system were seriously damaged by an accident, the consequences will not harm the public.

According to ERDA, the safety area has received considerable emphasis, many basic safety questions have been answered, and a large amount of technology is available. One major question yet to be answered is that of recriticality[1] occurring if a core disruptive accident happens. Before large commercial plants are built, the probability of a core disruptive accident happening must be shown to be sufficiently low so that it becomes unimportant or it must be demonstrated that such an accident does not have serious public consequences. As the LMFBR plants become larger so could the potential consequences of a core disruptive accident. A point could be reached where design options to maintain safety margins are not economically feasible; therefore, failure to satisfactorily resolve the core disruptive accident question might limit the size of commercial plants.

ERDA anticipates that safety work will be completed in the 1990s but that funding will continue to be provided for safety research and development for as long as LMFBRs are being built.

Several major facilities, including the Transient Reactor Test Facility in Idaho, are now used in the safety program. This facility is used to test the behavior of fuel under changing temperature and power conditions. One other

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1The reassembly of the molten fuel during an accident into a mass capable of releasing potentially large amounts of energy. Some experts hypothesize that an accident involving recriticality could cause an energy release sufficient enough to leak from the reactor containment building and release radioactive material to the environment.

major facility is planned--a Safety Research Experiment Facility.

The Safety Research Experiment Facility is presently estimated to cost $230 million and is expected to begin operations in the mid-1980s. This facility will provide a fast-flux zone for testing up to seven full-scale LMFBR fuel assemblies to and through total loss of fuel element integrity. It will enable data to be developed to address outstanding safety issues--such as the question of recriticality--and will provide input into the design evaluation process of commercial LMFBR designs and data to respond to concerns of licensing bodies and citizen groups. It will also provide the capability of conducting prototypic tests under conditions of hypothesized LMFBR accidents.

According to ERDA, this planned facility is not needed to provide safety data before the scheduled July 1982 operation of the Clinch River Breeder Reactor demonstration plant because conservative design features and margins are included in the present CRBR design. However, it is needed to provide data for the design of larger plants as these same conservatisms and margins impose substantial economic penalties on the cost of energy to be obtained.

COMPONENT DEVELOPMENT

The objective of this area is to insure the availability of plant components and systems with demonstrated capability of meeting the exacting performance requirements of commercial LMFBRs, including reliability, safety, economy, operability, and ease of maintenance. This area is in transition from focusing on near-term needs (FFTF and CRBR) to focusing on component sizes of interest to commercial plants. According to ERDA, progress to date in developing components, particularly those to be used in FFTF, has not been satisfactory.

According to ERDA, many component features are being developed which are applicable to large plants, but it is necessary to proof test the full-size components to provide assurance that they will operate reliably under conditions typical of power plant services. Facilities currently available within the program are inadequate for testing the large-size components. Consequently, a Plant Component Test Facility, which will serve as a test bed for commercial-size components, has been added to the LMFBR program plan. This facility is estimated to cost about $200 million and is planned for operation in the early 1980s. ERDA expects that testing components for the near commercial plant will be completed by 1984.

In addition to the Plant Component Test Facility, ERDA plans to construct a Radiation and Repair Engineering Facility--estimated to cost $36 million--for maintaining and repairing large, radioactive sodium-contaminated components.

Present emphasis in the component development area is on the development of components for CRBR. Fabrication of prototype components is scheduled to begin in 1975 with testing to follow. The critical components--the pump and steam generator--are scheduled for testing in 1977. According to ERDA, this will be early enough to allow rework, if necessary, based on the test results, before installing these components in CRBR.

PLANT EXPERIENCE

The objective of this area is to demonstrate the licenseability, operability, flexibility, safety, reliability, availability, inspectability, maintainability, environmental acceptability, and economy of LMFBR. The plant experience area of the LMFBR program is where technology developments are integrated into an operating reactor to demonstrate the feasibility of the total concept. According to ERDA, plant experience is acquired by designing, constructing, and operating a succession of plants--progressing in size through reasonable extrapolations of technology--until the commercial plant is reached. Limited experience has been achieved from operating several U.S. reactors, and more is expected from FFTF.

ERDA believes that successfully completing CRBR and the near commercial plant (see p. 8), together with the experience gained from foreign LMFBR programs, should provide adequate experience for the U.S. breeder industry. CRBR will serve to demonstrate LMFBR reliability, safety, licenseability, and environmental acceptability, focusing industry and utility efforts on establishing the commercial viability of the concept.

According to ERDA, the near commercial plant, referred to as the Near Commercial Breeder Reactor (NCBR), is to provide the large-scale plant experience necessary to initiate full industrial participation for commercializing the LMFBR. The experience of ERDA and private industry with this facility should determine how much work on the LMFBR concept is necessary before it is fully accepted by the nuclear industry and integrated into utilities' power production systems. NCBR is not well defined yet except that it is expected to be a large, commercial-size LMFBR (in the 1,000 to 1,500 MWe power range) which uses large, commercial-size components. This size would generate about four times as much power as CRBR.

ERDA plans to fund work on designs of large plants which must be begun before designing and constructing NCBR. These designs--known as LMFBR Target Plant Designs--are also expected to provide essential technical input to the full-size component development and testing program as well as to the rest of the LMFBR base technology effort.

Work on the LMFBR Target Plant Designs is expected to begin in mid-1975. Two or more reactor manufacturers are to be selected to develop engineering designs of commercial LMFBRs which these reactor manufacturers might propose to market. This effort is expected to last about 3 years.

The Electric Power Research Institute[1] has expressed an interest in participating with ERDA in the conduct of the Target Plant Designs and has indicated a willingness to share substantially in the costs. Negotiations are presently underway to determine the extent of the Institute's involvement and cost sharing arrangements.

AEC previously funded a similar design effort which ended in 1968. New designs are now needed, according to ERDA, because substantial changes in the program and considerable advances in the technology have occurred since 1968.

Uncertainties associated with NCBR

ERDA envisions that NCBR will be a cooperative project between the Government and the nuclear utility industry and that the Government's assistance to the project will be substantially less than that required for CRBR (presently estimated at about $1.5 billion). The cost estimate, schedule, and degree of industry participation has not yet been determined. However, AEC's preliminary estimate of NCBR's cost was $2.0 billion. ERDA expects that the nuclear utility industry will commit funds to the project beginning in 1977 and that the project will be completed in 1986.

Although they are not certain, ERDA officials told us that more than one NCBR may be needed and that the Government might need to provide funds to supplement industry investment for any additional NCBRs. ERDA officials told us that in the past under the Power Demonstratrion Plant Pro-

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[1]The Electric Power Research Institute, formed in 1972, is supported by all segments of the electric utility industry to fund electric research and development projects. Its goal is to develop a broad, coordinated, advanced technological program for improved electric power production, transmission, distribution, and utilization in an environmentally acceptable manner.

gram, AEC's approach was to provide funds for follow-on plants until their power costs[1] become competitive with then available power sources. If ERDA chooses this same approach, Government funds would be added to private industry investment for NCBRs until such time as the costs per installed kilowatt of breeder electrical generating capacity are about the same as for light-water reactors (or other power sources) of the same generating capacity. ERDA estimates the capital costs for the initial NCBR--not including research and development costs--could be as high as $1,000 per installed kilowatt of capacity. The same costs for a light-water reactor are now about $600 per installed kilowatt.

ERDA officials said that they have no sound basis for predicting the extent of cost sharing on the initial NCBR. The estimate of what the LMFBR program will cost through 2020 specifies that ERDA's contribution for NCBR will be $300 million. As pointed out on page 14, there is a large amount of uncertainty related to the $300 million in planned assistance.

FACILITIES USED IN THE LMFBR PROGRAM

In a July 1974 report to the Office of Management and Budget, AEC listed 96 facilities in the LMFBR program. AEC officials told us, however, that this list included both major and non-major facilities.

We identified 22 of these facilities, which AEC built or ERDA is presently building, as being major construction projects. ERDA plans to build eight more facilities for the program. These present and planned facilities are generally multipurpose facilities which have a relatively long useful life and large acquisition cost and are not limited to a narrow technical objective or task. The approximate total construction cost of these present and planned facilities, which is included in the LMFBR program cost estimate, is about $3 billion. Several of these facilities --such as EBR-II, FFTF, and CRBR--have been previously mentioned and discussed in this report.

Numerous other facilities, which ERDA does not consider major facilities, are used in the program. These include experimental support apparatus which have a relatively short

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[1]These costs include both capital power costs and fuel cycle costs. LMFBR fuel cycle costs are expected to be lower than light-water reactor fuel cycle costs. Consequently, LMFBR capital investment costs can be higher than those for light-water reactors and the total investment for the two types of plants could be competitive.

life and a single or limited purpose.

Appendix IV presents a listing of major facilities by LMFBR program area. Appendix V presents a detailed listing, including cost and schedule information, of those present and planned major LMFBR support facilities.

Information on certain key LMFBR facilities

FFTF

The FFTF is to be a key testing facility for fuels and materials used in the LMFBR program. In July 1967, the Congress authorized construction of FFTF which, at that time, was estimated to cost $87.5 million and scheduled to begin full-power operation in early 1974. Since congressional authorization, FFTF has experienced substantial cost growth and schedule slippage. The FFTF cost and schedule estimate has been revised several times. The latest official cost estimate (February 1974) for the construction of the facility is $420 million.[1] At this same time, the construction completion schedule had slipped to November 1977; no estimate was made for the full-power operation milestone.

The FFTF contractor is presently forecasting that an additional $92 million will be needed to construct the FFTF. Also, as of December 31, 1974, the latest field estimate for construction completion was August 1978, with full-power operation expected to occur 18 months later.

Sodium Pump Test Facility

The construction of the Sodium Pump Test Facility was authorized in the fiscal year 1966 budget. The estimate presented to the Congress for approval at that time was $6.8 million. In 1969 a review of the project by a private architect-engineering firm revealed that the project, with its then current scope, would cost $25.2 million.

To reduce estimated costs, the project scope was then revised to test sodium pumps having a capacity of about one-third the size of those initially anticipated to be tested. The reduced project scope resulted in a cost estimate of $12.5 million for the facility. This estimate was presented

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[1]This estimate is only for constructing the facility. An additional $505 million was estimated for equipment, research and development, and other supporting costs for a total program cost of $925 million. A complete estimate for these costs was not prepared when the initial $87.5 million estimate was prepared.

to and approved by the Congress as part of AEC's fiscal year 1972 budget request. In fiscal year 1974, this $12.5 million estimate was again revised up to $17.5 million. At that time, AEC stated that the reduced capability of the facility would not adversely affect the capability to test pumps up to the sizes needed for use in the forseeable future of the LMFBR program.

ERDA is presently planning modifications to this facility so it can test CRBR-size pumps, which are larger than the pumps for which the facility is presently designed. These modifications are presently estimated to cost $40 million, increasing the project's total cost to $57.5 million.

CRBR

CRBR will be the Nation's first demonstration LMFBR power plant. In September 1972, during hearings before the Joint Committee on Atomic Energy, AEC presented its estimate of what the demonstration plant would cost--$699 million; the Federal Government would provide $422 million through AEC and industry would provide the balance. The project was scheduled to achieve initial operation in 1979. Since then, the CRBR has incurred considerable schedule delay and cost growth. In September 1974, following an extensive effort to establish a reference design, schedule, and cost estimate, AEC estimated that the project will cost $1.736 billion and would not be initially operable until July 1982--an increase of more than $1 billion and a delay of about 3 years. Because of an open-ended commitment, the Federal Government's contribution to CRBR would increase to $1.468 billion. As a result, ERDA is planning to seek additional authorization for CRBR in early 1975.

As of March 1975, ERDA's Division of Reactor Research and Development was forecasting that CRBR would cost $1.771 billion and that the funding problems that the project is incurring will cause the project schedule to slip 3 months.

CHAPTER 3

MANAGEMENT OF THE LMFBR PROGRAM

ERDA's Division of Reactor Research and Development (RRD) is directly responsible for developing and directing the LMFBR program and for providing the needed technology to develop and support a commercially viable breeder reactor economy. It is also responsible for supporting other nuclear electric power concepts on an as-needed basis to meet future U.S. power demands. RRD recently made a number of changes designed to improve management of the LMFBR program.

ERDA has operations offices throughout the country to, among other things, administer the contractors' LMFBR activities within defined geographic areas.

RRD ORGANIZATION

RRD is organized on a project basis, that is, individual assistant directors are directly responsible for specific areas and projects within the division. Under this organization, there are 14 assistant directors, 8 of whom are involved directly in the LMFBR program. These are assistant directors for programs, reactor safety, engineering and technology, component engineering and development, LMFBR support facilities, commercial plant program management, CRBR program management, and FFTF program management. The other RRD assistant directors are assigned either to other reactor development programs (e.g., gas-cooled reactor projects) or to program support organizations (e.g., administration). (See appendix VI for an organization chart of RRD.)

RRD has been organized on a project basis since November 1973. Before then the division was operating on a functional basis with various assistant directors responsible for specific technological areas in the overall program. According to AEC, RRD was reorganized to give the individual assistant directors more direct authority and to establish defined areas of responsibility for major segments of the LMFBR development program.

MANAGEMENT CONTROL SYSTEM WITHIN RRD

RRD is in the process of implementing a new system for administering, managing, and controlling its various programs, of which the LMFBR is the most important. This management control system is intended to provide increased visibility and better control over RRD programs.

Several factors provided the impetus for RRD's new management system, including two GAO reports[1] to AEC regarding LMFBR program planning, delays in reaching agreement on programmatic and technical matters affecting the program, and a need to promptly keep top management better informed of problem areas. These factors focused top level attention on the management performance of RRD.

In June 1974, RRD contracted with a private consulting firm to identify ways of improving its management control system. Weaknesses of the former management system were identified and were used to develop objectives for improving the management system. The objectives were to:

--Insure proper visibility of RRD programs by proper long and short term planning.

--Provide the ability to forecast technical and financial problems. According to RRD, this should reduce the time the RRD staff used in "fire-fighting" (i.e., responding to problems that arise during the course of day-to-day operations).

--Establish closer control over the costs and schedules of RRD programs and supporting projects combined with a method of tracking the activities involved in the various aspects of them.

--Provide adequate and timely reports to upper management.

--Permit more attention by the assistant directors to the management of their programs.

--Reduce and simplify all RRD reporting requirements.

The integration and implementation of the management control system into the management structure of RRD will be a gradual process and is expected to take 1 or 2 years.

The management control system consists of five management functions: planning, directing, information management, reporting, and reviewing. The planning and directing functions have progressed well toward full integration and implementation into the system. The information management, re-

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[1]Letter report to AEC General Manager, July 17, 1973, regarding the management of the LMFBR program and letter report to the Chairman, AEC, June 29, 1973, regarding the need for better reporting requirements on AEC's construction projects (B-164105).

porting, and reviewing functions are in the early stages of development. Each of these functions are briefly discussed below.

Planning

This function consists of two primary elements--a Division Plan and supporting Assistant Director Plans. The Division Plan will be RRD's basic management planning document which identifies with its objectives and the strategy for achieving the objectives. It should provide an overall picture of RRD programs and activities, the responsibilities for carrying out these programs, and the objectives they support--plus the resources and constraints within which they are to be accomplished. The plan is to be the focal point for control and visibility of all RRD activities at the director's level and is to serve as the base for gauging the progress of programs and the performance of various levels of management within RRD. Before initiating this Division Plan concept, top RRD management had no formal overall planning document, except budget oriented type information.

The Assistant Director Plans will be the basic management planning document for each assistant director. Each assistant director is to prepare these plans based on the Division Plan. The plans must define the objectives, activities, schedules, budgets, and milestones for the assistant director's area of responsibility. These plans, which must be approved by the Director, RRD, should provide long-range visibility and near-term control of the activities of each assistant director. They are to be the basis for tracking and comparing technical and financial status. The plans will be issued annually and updated at least once during the year to reflect progress and changes in direction.

Directing

This function is designed to insure that the established plans are implemented properly and consistently throughout and among RRD. The director's primary means of directing the efforts within RRD will be through policy and procedural guides and various program direction letters in which the director assigns objectives to the assistant directors. The assistant directors are responsible for issuing to the field various program direction letters to authorize ongoing work. The division director formerly did this.

Information management

The improved information management system, when fully developed, should direct relevant programmatic and project data to the appropriate offices and individuals within RRD.

Because of the large amounts of such information generated within the program, such a system, if properly implemented, should provide program management with a much needed mechanism for filtering out unnecessary information which can hinder management efficiency.

Reporting

The reporting elements of the management control system will specify what reports are to be produced, the information that is to be included in the reports, and the format that is to be followed. This reporting system is intended to provide consistent, meaningful, and timely information to RRD management.

The information management and reporting functions are to work together to insure that the RRD management is provided with the information they need to meet their respective programmatic responsibilities and are not inundated with unnecessary data and reports.

Reviewing

This function's objective is to provide RRD management with feedback and assessment on critical programs and projects within RRD (e.g., FFTF, CRBR). There are two key review elements, the program control center and formal project reviews, which formerly did not exist. A program control center is to be established and will display updated project information and the status of all RRD programs. Formal project review meetings, at which the assistant directors will present the status of their programs to RRD's director, are to be held on regularly scheduled basis. The main point of these meetings is to be a thorough discussion of problems, including cause, impact, remedial action, and prognosis. Several project reviews have already been held.

CONCLUSION

As previously pointed out, ERDA has identified weaknesses in its overall management control system and it has developed a number of objectives aimed at improving the system. These goals, if achieved, should reasonably insure that ERDA management will have greater visibility over LMFBR programs and that it will be in a position to better focus management attention and direction over those areas of the program having problems.

ERDA expects that integrating and implementing the new management control system will be a gradual process and that it will take 1 to 2 years to fully implement. Because of the importance of this program in helping to solve the Nation's energy problems and because of the large amounts of funds estimated to be spent on LMFBR development, ERDA should strive to implement the system as soon as possible.

The actions ERDA has taken and is taking to improve its management control system are steps in the right direction.

CRBR PROJECT ORGANIZATION

In July 1973, after extensive negotiations and hearings before the Joint Committee on Atomic Energy, AEC entered into a contract with the Tennessee Valley Authority, Commonwealth Edison Company, and Project Management Corporation to build the Nation's first LMFBR demonstration plant. This project is being funded jointly by the Government and private industry, particularly the Breeder Reactor Corporation, which administers the financial contributions from the Nation's electric utilities. Project Managment Corporation, a not-for-profit corporation formed in 1972, is providing overall management and coordination for designing, constructing, and operating the plant and has the lead role for the non-nuclear portions of the plant. The Tennessee Valley Authority is providing the Clinch River site for the project. It will own and operate the plant and will purchase the power produced by the plant. Commonwealth Edison is supplying engineering management and purchasing services for the project. ERDA has the lead role responsibility for the nuclear portion of the project and, through the CRBR project office, provides Project Management Corporation contract administration services on an as-needed basis.

A three-man steering committee with representatives from ERDA, the Tennessee Valley Authority, and Commonwealth Edison directs the Project Management Corporation role (through the Project Management Corporation's General Manager). This group implements project policy and agreements. ERDA's representative is the director of RRD. (See appendix VII for a chart showing the current CRBR management organization.)

This organizational arrangement for the project is complex and potentially cumbersome. This has been recognized by the project participants involved. Officials involved in the project told us that no major problems have thus far resulted from this complex organization structure. However, ERDA officials told us that the reason no problems have resulted is because of the compatibility of the personalities of the two individuals most directly involved in managing the project--the Project Management Corporation's general manager and the RRD assistant director for the demonstration plant project. These two individuals, according to ERDA officials, have been able to work out any differences and have been able to make the project go.

As evidence of this relationship and its effects on the management of the project, we noted a letter had been submitted by the Project Management Corporation's general manager to RRD management reflecting problems Project Management Corporation management had administering its responsibilities. RRD management officials disregarded the letter and said that the individuals involved will work out the problem and prevent any conflicts.

In our view, the organizational arrangement for the CRBR, which depends heavily upon the personalities of the individuals involved, may hinder the effective management of the design and construction of CRBR and, consequently, represents a potential risk to the project. Unless the organizational relationships and management processes are streamlined, cost overruns and schedule delays might follow. An ERDA review group reached similar conclusions. Now, when the Government is expected to commit an additional $1 billion to the project, may be an appropriate time to seek a change in the present contractual arrangement to strengthen and streamline Government control over the project.

On March 10, 1975, ERDA submitted to the Joint Committee on Atomic Energy for its approval proposed legislation and underlying documents that would provide for a new management structure for the project. Essentially, management control of the project would be transferred from the Project Management Corporation to ERDA, commensurate with the Government's investment in the project. This new management structure is intended to strengthen and streamline Government control over the project.

In a April 4, 1975, report to the Joint Committee on Atomic Energy entitled "Comments on Energy Research and Development Administration's Proposed Arrangement for the Clinch River Breeder Reactor Demonstration Plant Project" (RED-75-361), we pointed out that the various documents ERDA submitted to the Joint Committee did not clearly delineate the manner in which the project would be managed, but rather contained ambiguous and seemingly inconsistent language regarding responsibilities and authorization for management. In addition, we stated that such inconsistencies suggested that ERDA would not be able to exercise the usual management prerogatives in the areas of design and other changes and that it might be subject to restraints in other management areas.

CHAPTER 4

FUNDING FOR ENERGY RESEARCH AND DEVELOPMENT

Energy Research and Development (R&D) funding has grown markedly since 1971 and is now one of the fastest growing areas of the Federal budget. Energy R&D funding, as a percentage of total Federal R&D funding, has risen from 2.3 percent in 1969 to an estimated 8.1 percent in 1976, as shown in the table below.

Fiscal year	Total Federal R&D	Total Federal energy R&D	Percentage of energy to total R&D
	-------(billions)-------		
1969	$16.3	$ .38	2.3
1970	15.9	.38	2.4
1971	16.2	.42	2.6
1972	17.2	.54	3.1
1973	17.6	.67	3.8
1974	18.3	1.02	5.6
1975 (estimated)	19.8	1.67	8.4
1976 (estimated)	22.6	1.84	8.1

AEC, Department of the Interior, the National Science Foundation, and the Environmental Protection Agency had carried on the bulk of the Federal energy R&D effort. With the establishment of ERDA in January 1975, most of the effort will be centered in that agency.

The Office of Management and Budget has maintained data on total Federal energy R&D funding since fiscal year 1973. Before that time, the National Science Foundation was the only central source of information on Federal energy R&D.

PROPOSED FISCAL YEAR 1976 ENERGY R&D PROGRAM

The proposed fiscal year 1976 Federal budget estimate includes about $1,837 million for energy R&D. These funds are to support a broadly based effort on technologies for energy supply, environmental control, and conservation. The following table shows the proposed Federal energy R&D program for fiscal year 1976 along with historical and planned funding for energy R&D program areas.

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Program area	1973	1974	1975	1976	Estimated total FY 1977-80
	Fiscal years (millions)				
Conservation	$ 32.2	$ 38.7	$ 86.2	$ 87.8	$ 353.9
Oil, gas, and shale	18.7	13.5	40.9	44.0	233.5
Coal	85.1	96.6	394.3	396.2	2,042.2
Environmental control	38.4	65.8	103.3	82.9	231.8
Nuclear fission	406.5	644.1	761.8	876.4	4,429.3
Nuclear fusion	74.8	112.0	180.0	226.0	1,887.2
Solar, geothermal, and others	16.5	45.2	102.0	123.4	598.7
Total	$672.2	$1,015.9	$1,668.5	$1,836.7	$9,776.6

The energy R&D program is designed to accelerate the development of technologies needed to achieve and maintain a capability to more fully utilize domestic energy resources within acceptable environmental and economic costs.

ERDA's energy R&D accounts for a major portion of the total Federal energy R&D budget. The following table shows this relationship since fiscal year 1969.

Fiscal year	Total Federal energy R&D	AEC-ERDA energy R&D	Percentage AEC-ERDA energy R&D to total Federal energy R&D
	(millions)		
1969	$ 376	$ 277	73.7
1970	382	284	74.3
1971	419	332	79.2
1972	537	404	75.2
1973	672	499	74.3
1974	1,016	648	63.8
1975	1,669	[a]1,019	61.6
1976 (estimated)	1,837	[a]1,365	74.3

[a]These figures include energy R&D programs transferred from other agencies to ERDA as of January 19, 1975.

As indicated above, AEC funding as a percentage of the total Federal energy R&D budget had decreased from 73.7 percent in 1969 to 63.8 percent in 1974. With the establishment of ERDA, the percentage of the ERDA energy R&D budget increased substantially to an estimated 74.3 percent in fiscal year 1976.

LMFBR PROGRAM FUNDING

The largest nuclear program is ERDA's civilian fission reactor program. Most of this program is devoted to developing LMFBR. The LMFBR program is a major portion of the Nation's effort to achieve energy self-sufficiency in the next decade and to maintain it into the next century. Although the amount of LMFBR expenditures has been increasing, the percentage of these expenditures to total Federal energy R&D has been decreasing since fiscal year 1973, as shown in the following chart.

Fiscal year	AEC-ERDA LMFBR costs	Total Federal energy R&D	Percentage LMFBR costs to total Federal energy R&D	AEC-ERDA energy R&D	Percentage LMFBR costs to AEC-ERDA energy R&D
	-----(millions)-----			(millions)	
1969	$133	$ 376	35	$ 277	48
1970	144	382	38	284	51
1971	168	419	40	332	51
1972	234	537	44	404	58
1973	280	672	42	499	56
1974	354	1,016	35	648	55
1975	481	1,669	29	[a]1,019	47
1976 (estimated)	474	1,837	26	[a]1,365	35

[a]These figures include energy R&D programs transferred from other agencies to ERDA as of January 19, 1975.

Regulatory costs for LMFBR program activities

The AEC-Regulatory (now the Nuclear Regulatory Commission) costs for their activities relating to the licensing and surveillance of LMFBRs, as discussed on page 10, are not included in the above figures. These costs amounted to $1.1 million in fiscal year 1973, $1.1 million in fiscal year 1974, and are expected to be $1.5 million in fiscal year 1975 and $21.2 million during fiscal years 1976 through 1980.

CHAPTER 5

FOREIGN LMFBR PROGRAMS

LMFBR is a high priority national energy development program of five other major industrial nations. The United Kingdom, France, Japan, West Germany, and the Soviet Union have work underway on breeder reactors. The United Kingdom, France, and the Soviet Union already have demonstration-size breeders in operation; West Germany and Japan have plants scheduled for operation by 1979 and 1980, respectively. The following table, taken from AEC-ERDA documents, lists the LMFBR projects throughout the world which are operable, under construction, or planned.

Name	Country	Power MWt	Power MWe	Initial Operation
Operable				
BR-10 (note a)	USSR	10	--	1959
Dounreay Fast Reactor	United Kingdom	72	14	1959
EBR-II	United States	62.5	16	1963
Rapsodie	France	40	--	1967
BOR-60	USSR	60	12	1970
BN-350 (note b)	USSR	1,000	150	1972
Phenix	France	600	250	1973
Prototype Fast Reactor	United Kingdom	600	250	1974
Under construction or planned				
Joyo (note c)	Japan	100	--	1975
KNK-2 (note d)	West Germany	58	20	1975
BN-600	USSR	1,500	600	1977
FFTF	United States	400	--	1977
SNR-300 (note e)	West Germany	730	300	1979
Super Phenix (note f)	France	3,000	1,200	1979
Monju	Japan	720	300	1980
Commercial Fast Reactor	United Kingdom	3,125	1,320	1981
CRBR	United States	1,000	400	1982
SNR-2 (note f)	West Germany	5,000	2,000	1984

[a]Initially started up at 5 MWt and power level increased to 10 MWt in 1973.

[b]Dual purpose: 150 MWe for electric power and 200 MWe equivalent for desalination.

[c]To be operated to 50 MWt initially.

[d]Operable as thermal reactor (KNK-1) until late 1974.

[e]In cooperation with Belgium and the Netherlands.

[f]Planned effort by French, German, and Italian electric utilities.

STATUS OF THE MAJOR LMFBR PROGRAMS

We obtained information on the foreign LMFBR programs from ERDA-AEC officials and documents.

France

France has one of the more advanced foreign programs in reactor development and has perhaps the greatest national commitment to the LMFBR concept. The French fast reactor research program began with fundamental research on liquid metals in the early 1950s. Construction of the Rapsodie fast breeder reactor began in 1962 with operations beginning in 1967. The successful operation of the Rapsodie reactor led to the French Government's decision the next year to build Phenix, a 250 MWe LMFBR prototype. Construction of Phenix was started in late 1968 and completed in late 1973. The reactor began operations in 1973 and reached full power in March 1974. As of February 1975, Phenix was operating smoothly and had encountered no major problems.

The French, in a combined effort with German and Italian electric utilities, are now planning for Super Phenix, a 1,200 MWe commercial fast breeder power station. Construction is expected to start in March 1975, after 1 year of successful Phenix operation. Super Phenix represents a major extrapolation in existing technology. Phenix is not prototypical of Super Phenix in a number of important components, such as steam generators, intermediate heat exchangers, and fuel.

France is also considering entering the commercial market with a 450 MWe Phenix which would be based on the Phenix design and components. The plant would be a direct extrapolation from Phenix without any new technology risk.

United Kingdom

Studies of fast reactors in the United Kingdom started in the early 1950s. An early step in the United Kingdom LMFBR effort was their Atomic Energy Authority's 1955 decision to build the 14 MWe Dounreay Fast Reactor. The purpose of this reactor, which began operations in 1959, was to demonstrate the feasibility and safety of LMFBRs. It has also served as a facility to test fuels and materials.

As a result of the successful operation of the Dounreay Fast Reactor, construction of the 250 MWe Prototype Fast Reactor was started in 1966. This reactor began operations in 1974 and is currently operating at low power. Full power operation is expected in early 1975. Problems encountered in constructing and commissioning this reactor resulted in about a 2-year delay in schedule.

The detailed design of commercial fast breeders is currently underway in the United Kingdom. The construction of a commercial fast reactor of 1,300 MWe is scheduled to begin in 1977 with operations expected to begin in 1981 or 1982.

Japan

The Japanese Atomic Energy Commission together with electric utilities and reactor manufacturers began a study of nuclear power reactors in the mid-1960s. On the basis of this study, the Japanese Government established the Power Reactor and Nuclear Fuel Development Corporation in 1967. The goal of this corporation was to bring LMFBRs into practical use as power producers by the latter part of the 1980s.

To achieve this goal, the corporation is developing a 100 MWt experimental fast breeder reactor, Joyo, and a 300 MWe prototype LMFBR, Monju. Construction of Joyo was started in 1970 and operations are expected to begin early in 1975. Design work on Monju is presently underway with construction planned to start in 1975 or 1976 and operations expected to begin in 1979 or 1980. The main purpose of this project is to demonstrate the performance, reliability, and economy of LMFBR nuclear powerplants as well as to gain experience for larger commercial plants. The conceptual design for a 1,500 MWe commercial LMFBR has also been completed with construction presently planned to start around 1980.

West Germany

West Germany has no large national atomic energy agency. Instead, their Federal Government provides financial assistance to individual German states for nuclear energy research and development. The German fast reactor program was started in 1960 at the Karlsruhe Nuclear Research Center. Construction of a 20 MWe sodium cooled thermal reactor was started in 1966; it began operation in 1972. It is being modified for operation as a fast reactor (KNK-2) and is scheduled to be placed in operation in late 1975.

The commercial design of a 300 MWe prototype LMFBR (SNR-300) was begun in 1966-67 as a jointly financed project by West Germany (70 percent), Belgium, and the Netherlands (about 15 percent each). Luxembourg also participated. Its construction began in early 1973. The reactor is expected to start operation in 1979.

In 1971 a West German utility company and a French utility company signed an agreement to build two commercial LMFBRs. Later, Italy joined the agreement on a one-third participation basis. The first plant (Super Phenix) is to be 1,200 MWe; construction in France is to start in 1975. The second plant (SNR-2) is expected to be 2,000 MWe; construction is planned to start in West Germany in 1979.

Union of Soviet Socialist Republics

The USSR program is one of the more advanced foreign programs in reactor development. The USSR fast breeder research and development program is an effort of the State Committee for the Utilization of Atomic Energy and the Ministry for Power and Electrification. The program started in 1955 with the operation of a small plutonium-fueled reactor. A 100 KWt[1] mercury-cooled, plutonium-fueled reactor was built in 1956. This facility was reworked into a sodium-cooled, plutonium-fueled reactor of 5 MWt power which went into operation in 1959. The reactor was modified for operation at 10 MWt in 1973 (BR-10).

During the latter part of 1963, design work was initiated on a 60 MWt experimental LMFBR. Construction of this reactor, BOR-60, began in 1965 and operations began in 1970.

The two major Soviet projects are the BN-350 and the BN-600. Construction of the BN-350 fast breeder reactor began in early 1964. This dual purpose (power and water desalting) 1,000 MWt LMFBR provides the equivalent of 350 MWe in steam. The reactor began operations at the end of 1972 and was placed in commercial operation in July 1973.

The USSR is building the world's largest LMFBR--the BN-600. Construction of this 600 MWe reactor started in late 1968 and is expected to begin operations during 1977. It has been reported that the Soviets are designing an LMFBR in the 1,000-1,500 MWe power range.

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[1]A kilowatt thermal; one-thousandth of a megawatt thermal. See footnote 1 on page 7.

COMPARISON OF U.S. PROGRAM WITH FOREIGN PROGRAMS

The U.S. approach to LMFBR's development has been to accumulate the required technological base for designing, constructing, and operating LMFBRs in the private sector. The U.S. program has emphasized an understanding of the full range of technology problems and their resolution before initiating the powerplant hardware phase. The U.S. program, for example, includes FFTF as a necessary and vital tool to obtain substantial long-range improvements in fuel.

The foreign programs differ from the U.S. program in respect to program approach and emphasis. For example, the USSR fast reactor program consists of constructing large-scale units of different designs so that any deficiencies in plant design, fabrication practices, and technology can be corrected. The French program has emphasized constructing and operating fast reactor prototypes of increasing size. The Japanese approach is similar to the U.S. approach in that substantial efforts are directed at developing the necessary technology. Moreover, the high population density of Japan and the frequency of earthquakes, as well as other factors and circumstances, have resulted in licensing criteria and public awareness of nuclear plants similar to that in the United States. Another distinction is that the foreign programs do not include an FFTF-type facility because these countries have not believed this type of facility to be necessary for their programs. ERDA told us that these foreign countries could, if they desired, perform certain experiments on the FFTF and that one country, West Germany, has approached ERDA on the possibility of doing this.

Although there are some differences in approach and emphasis, all of the programs either contain or plan many of the same elements that are in the long-range U.S. program. The foreign programs either have in operation or under construction or have planned intermediate size LMFBR plants. All these programs are aimed ultimately at commercial-size plants in the thousand megawatt or greater range.

AEC ASSESSMENT OF THE FRENCH LMFBR PROGRAM

According to AEC, the French LMFBR program represents a strong effort with centralized leadership. Less stringent safety requirements and regulatory procedures, concentrated efforts on one advanced nuclear system, and a strong engineering team with requisite authority and capability to expedite the LMFBR efforts have undoubtedly been contributing factors in the rapid advance of the French LMFBR program.

In October 1974, AEC gave the Office of Management and Budget an assessment of the commercial potential for the French LMFBR program, the attractive features and specific problems associated with the French LMFBR, and the impact if the United States were to depend primarily on French technology for commercial LMFBRs.

According to AEC, the safety and licensing requirements for LMFBRs in France are less comprehensive than the U.S. requirements. The rigorous requirements of the United States would tend to reduce the commercial potential of the French LMFBRs here. The French LMFBRs would encounter difficulties getting licensed in the United States in several areas, including

--meeting seismic and tornado design criteria and

--using and enforcing a formal quality assurance program using U.S. derived codes and standards.

AEC said that these difficulties are not insurmountable but that a large amount of time and some redesign would be needed to meet U.S. regulatory demands. However, the licenseability of reactors of French design has not been explored in the United States.

AEC told the Office of Management and Budget that official capital investment and operating costs for the French LMFBRs are not available. Consequently, AEC was unable to make an accurate projection of their economic attractiveness in the U.S. market.

According to AEC, some of the attractive features of the French LMFBRs are:

--operating experience from 250 MWe Phenix,

--experience with two steam generator designs for Super Phenix,

--partial (not necessarily complete) component and sub-component testing, and

--apparent low costs.

Some of the problems associated with using French technology are:

--Unknown quality assurance program, but reported to be minimal for the Phenix.

--Unknown availability and cost of fuel.

--Licensing of foreign reactors on U.S. soil would require substantial analysis and perhaps tests.

--Insuring the availability of spare parts and technology for repair and maintenance.

--Non-availability of programmatic details, particularly fuel cycle and component manufacture. The United States could be locked into buying certain French items and services for years to come.

AEC told the Office of Management and Budget that, if the United States depended primarily on French technology for commercial LMFBRs, the U.S. balance of payments would be adversely affected and that the United States might not achieve its energy self-sufficiency goal. Also, depending upon French technology would negate achieving the objectives of establishing a self-sufficient and growing nuclear power industry and the maintenance of U.S. technological leadership in the world by means of a vigorous domestic nuclear power program.

ERDA REVIEW GROUP ASSESSMENT OF POTENTIAL USE OF FOREIGN PROGRAMS

In their January 1975 report on the LMFBR program, an ERDA review group said that foreign LMFBR programs can contribute important data and information to the U.S. program. The group also said that the U.S. program could make use of foreign programs under several specific arrangements but that none of these arrangements could be expected to save any large identifiable amount of U.S. effort. These arrangements are:

--Obtaining, under cooperative arrangements, technical information which would otherwise be developed independently. This would include the purchase of foreign data.

--Purchasing components developed in the foreign programs.

--Testing U.S.-developed components and fuel in foreign testing facilities.

The group recommended that

"* * * an active program to obtain and make use of foreign data and experience should be pursued and, if suitable LMFBR components are developed in foreign programs their procurement should be considered."

The review group also considered other courses of action, such as (1) relying on obtaining information from a foreign plant instead of building an intermediate-size plant in the United States and (2) depending totally on foreign sources for LMFBR technology and powerplants. The group concluded

> "* * * that it would be impractical to substitute foreign reactor experience and technology for critical elements of the U.S. program, such as the construction of the CRBR."

They also said that it is possible in the future to import fully developed LMFBRs from foreign manufacturers, designed for U.S. conditions and to U.S. standards. However, they concluded

> "* * * that such dependence on importation of an as yet undeveloped technology involves too much risk because of the uncertainty of the success and timing of the foreign programs. For so important a system, a strong U.S. program of development and a well developed indigenous competence for LMFBR construction are essential."

MATTER FOR CONSIDERATION
BY THE CONGRESS

If the Congress wants to know whether greater reliance can be placed on the use of foreign LMFBR technology, it should explore with ERDA in greater depth the advantages and disadvantages of using foreign LMFBR technology.

CHAPTER 6

SCOPE OF REVIEW

We made our review at ERDA headquarters in Germantown, Maryland. We held discussions with ERDA staff responsible for managing the LMFBR program and reviewed programmatic and fiscal and budgetary documents relating to the program and ERDA documents regarding the status of foreign LMFBR programs.

We visited Argonne National Laboratory, Chicago, Illinois, to obtain data on LMFBR support facilities under their cognizance. ERDA obtained similar information for us from other national laboratories and contractors.

To develop information on total Federal energy research and development, we held discussions with and obtained documents from Office of Management and Budget and National Science Foundation officials.

LMFBR PROGRAM COST PROJECTIONS (1975 THROUGH 2020)

LMFBR INTRODUCTION DATE--1987

(millions of FY 76 dollars)

	FY 1975	FY 1976	3 Mos. Transition	FY 1977	FY 1978	FY 1979	Total 1975-79	Total 1975-87	Total 1987-2020	Total 1975-2020
LMFBR:										
R&D:										
FFTF	65	50	13	50	40	40	258	565	265	830
CRBR	42	50	13	58	46	44	253	351	-	351
Support facilities	43	51	14	65	68	69	310	776	201	977
Technology	52	56	16	62	65	68	319	838	121	959
Engineering	48	55	15	75	102	134	429	1170	84	1254
COOPERATIVE PROJECTS:										
CRBR	14	35	20	169	178	177	593	838	-	838
NCBR	-	-	-	5	20	70	95	300	-	300
CAPITAL EQUIPMENT	19	18	5	25	26	28	121	291	53	344
CONSTRUCTION PROJECTS:										
FFTF	132	80	-	100	-	-	312	312	-	312
Plant Component Test Facility	-	-	-	13	53	65	131	200	-	200
Radiation & Repair Engineering Facility	-	-	-	-	4	13	17	36	-	36
High Performance Fuel Laboratory	-	-	-	9	18	18	45	54	-	54
LMFBR Fuels & Materials Examination Facility	-	-	-	-	5	18	23	50	-	50
LMFBR Fuels Reprocessing Hot Pilot Plant	-	-	-	-	9	37	46	300	-	300
Sodium Pump Test Facility	-	-	-	-	9	18	27	40	-	40
Miscellaneous projects	15	22	2	19	22	19	99	202	-	202
Total LMFBR	430	417	98	650	665	818	3078	6323	724	7047
SUPPORT TECHNOLOGY (LMFBR):										
Safety:										
R&D	36	41	11	63	69	77	297	778	245	1023
Equipment	4	3	1	5	6	6	25	62	18	80
Construction:										
Safety Research Experiment Facility	-	-	-	13	29	61	103	230	-	230
Sodium Loop Safety Facility Upgrade	-	-	-	-	4	3	7	7	-	7
Advanced Fuel Technology	11	13	4	20	25	30	103	378	108	486
Total support technology (LMFBR)	51	57	16	101	133	177	535	1455	371	1826
Total LMFBR and support technology	481	474	114	751	798	995	3613	7778	1095	8873

LMFBR PROGRAM MAJOR PARTICIPANTS BY PROGRAM AREA

REACTOR PHYSICS

Aerojet Nuclear Corporation
Argonne National Laboratory
Brookhaven National Laboratory
General Electric Company
Hanford Engineering Development Laboratory
Los Alamos Scientific Laboratory
Holifield National Laboratory
Westinghouse Electric Corporation

FUELS AND MATERIALS

Argonne National Laboratory
Atomics International
Battelle Memorial Institute
Combustion Engineering
General Electric Company
Hanford Engineering Development Laboratory
Los Alamos Scientific Laboratory
Naval Research Laboratories
Holifield National Laboratory
Westinghouse Electric Corporation

FUEL RECYCLE

Aeroject Nuclear Corporation
E. I. du Pont de Nemours & Co.
Hanford Engineering Development Laboratory
Los Alamos Scientific Laboratory
Oak Ridge Gaseous Diffusion Plant
Holifield National Laboratory
Sandia Corporation

SAFETY

Aeroject Nuclear Corporation
Argonne National Laboratory
Atomics International
General Electric Company
Hanford Engineering Development Laboratory
Los Alamos Scientific Laboratory
Holifield National Laboratory
Southwest Research Institute
Westinghouse Electric Corporation

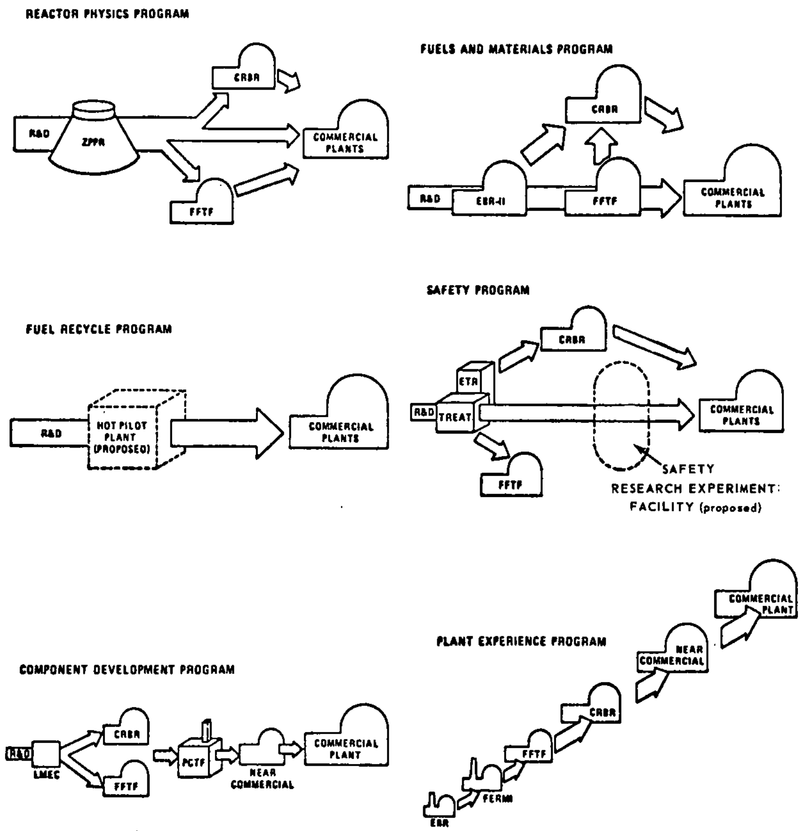
COMPONENT DEVELOPMENT

Aerojet General Corporation
Aerojet Nuclear Corporation
Argonne National Laboratory
Atomics International
General Electric Company
Hanford Engineering Development Laboratory
Holifield National Laboratory
Westinghouse Electric Corporation

PLANT EXPERIENCE

Argonne National Laboratory
Atomics International
Bechtel Corporation
Burns and Roe, Inc.
General Electric Company
Hanford Engineering Development Laboratory
Westinghouse Electric Corporation

LMFBR PROGRAM FACILITY RELATIONSHIPS



LMFBR PROGRAM MAJOR FACILITIES BY PROGRAM AREA

REACTOR PHYSICS

Fast Neutron Generator
Oak Ridge Electron Linear Accelerator
Tower Shielding Facility
Zero Power Plutonium Reactor
Zero Power Reactor-6
Zero Power Reactor-9

FUELS AND MATERIALS

Experimental Breeder Reactor-II
General Electric Test Reactor
Hot Cells
Hot Fuel Examination Facility
LMFBR Fuel Pilot Fabrication Line
Transient Reactor Test Facility
Fast Flux Test Facility (note a)
LMFBR Fuels and Materials Examination Facility (note b)

FUEL RECYCLE

High Performance Fuel Laboratory (note b)
LMFBR Fuels Reprocessing Hot Pilot Plant (note b)

SAFETY

Fuel Failure Mockup
Hot Fuel Examination Facility
Power Burst Facility
Transient Reactor Test Facility
Sodium Loop Safety Facility (note a)
Safety Research Experiment Facility (note b)

COMPONENT DEVELOPMENT

High Temperature Sodium Facility
Small Component Evaluation Loop
Small Component Test Loop
Sodium Components Test Installation (note c)
Alkali Metal Cleaning Facility (note a)
Component Handling and Cleaning Facility (note a)
Large Leak Test Rig (note a)
Sodium Pump Test Facility (note a)
Plant Component Test Facility (note b)
Radiation and Repair Engineering Facility (note b)
Transient Test Facility (note b)

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PLANT EXPERIENCE

Experimental Breeder Reactor-I (note d)
Experimental Breeder Reactor-II
Enrico Fermi Atomic Power Plant (note d)
Southwest Experimental Fast Oxide Reactor (note d)
Fast Flux Test Facility (note a)
Clinch River Breeder Reactor (note b)
Near Commercial Breeder Reactor (note b)

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[a] Under construction

[b] Planned

[c] Being modified

[d] Decommissioned

SCHEDULE OF ERDA-FUNDED FACILITIES USED IN SUPPORT OF THE LMFBR PROGRAM

LOCATION ABBREVIATIONS

ANL	Argonne National Laboratory, Chicago, Illinois
HEDL	Hanford Engineering Development Laboratory, Richland, Washington
HNL	Holifield National Laboratory, Oak Ridge, Tennessee
INEL	Idaho National Engineering Laboratory, Idaho Falls, Idaho
LMEC	Liquid Metal Engineering Center, Santa Susana, California

CURRENT LMFBR PROGRAM SUPPORT FACILITIES

Name of LMFBR support facility	Location	Relative use in support of LMFBR program	Date facility began operations	Facility costs: Estimated cost at time of authori-zation	Facility costs: Actual cost to construct facility	Facility costs: Amount costed on subsequent changes through 8/74	Construction schedule: Date facility authorized	Construction schedule: Date construction started	Construction schedule: Estimated construction completion date at time of authorization	Construction schedule: Actual construction completion date	Operating costs: Estimated annual operating cost at time of authorization	Operating costs: Actual annual operating costs	Operating costs: Estimated future operating costs	Facility life: Expected useful life of the facility in LMFBR program	Facility life: Estimated useful life at time of authorization	Program area(s)	Statement of facility's contribution to the program
1. Experimental Breeder Reactor-II (EBR-II) and Hot Fuel Examination Facility/South (HFEF/S)	ANL	100%	1964	[a]$29,100,000	[a]$32,285,000	$9,749,000	1956	1957	1962	1963	(b)	[c]FY 73 $10,451,000 FY 74 $9,892,000	[c]FY 75 $13,336,000 FY 76 $15,870,000	Through FY 1985	10 years	Fuels and materials, plant experience	Proof testing of instrumentation sensors and related equipment in high temperature irradiation environment.
2. Fast Neutron Generator (FNG)	ANL	100	1969	1,900,000	2,080,000	313,000	1967	1967	1968	1969	(b)	FY 73 $665,000 FY 74 $650,000	FY 75 $770,000 FY 76 $880,000	Through FY 1990	(b)	Reactor physics	Determination of neutron cross section and microscopic nuclear properties of fissile, fertile, structural and other LMFBR materials.
3. Hot Fuel Examination Facility/North (HFEF/N)	ANL	100	1972	10,200,000	10,200,000	1,169,000	1968	1968	1971	[d]1971	$1,300,000	[e]FY 73 $4,023,000 FY 74 $4,309,000	[e]FY 75 $5,172,000 FY 76 $6,350,000	Beyond 1990	25 years	Fuels and materials, and safety	Remote examination (both destructive and non-destructive) of irradiated fuel experiments and structural materials experiments.
4. Shielded Fuel Examination Facility	ANL	95	(b)	(f)	1,617,000	4,811,000	1958	1958	(g)	1963	(b)	(h)	(h)	Life of the LMFBR program	(b)	Fuels and materials	Preparation, disassembly, non-destructive and destructive examination, mechanical testing of fuel and materials experiments.
5. Transient Reactor Test Facility (TREAT)	ANL	100	1959	(b)	1,048,000	240,000	1958	1958	(b)	1958	(b)	[i]FY 73 $4,155,000 FY 74 $5,438,000	[i]FY 75 $5,582,000 FY 76 $8,976,000	Life of the LMFBR program	(b)	Fuels and materials, and safety	Provides an air-cooled thermal heterogeneous system designed to evaluate reactor fuels and structural materials under conditions simulating various types of nuclear excursions and transient undercooling situations, and is available for neutron radiography of experimental capsules and elements.
6. Zero Power Plutonium Reactor (ZPPR)	ANL	100	1969	3,000,000	3,699,000	920,000	1964	1966	1967	1968	(b)	(j)	(j)	Through 1990	1977	Reactor physics	Obtaining integral reactor physics parameters from fast spectrum critical assemblies in benchmark, engineering mock-up and special purpose experiments.

CURRENT LMFBR PROGRAM
SUPPORT FACILITIES

Name of LMFBR support facility	Location	Relative use in support of LMFBR program	Date facility began operations	Facility costs: Estimated cost at time of authorization	Facility costs: Actual cost to construct facility	Facility costs: Amount costed on subsequent changes through 8/74	Construction schedule: Date facility authorized	Construction schedule: Date construction started	Construction schedule: Estimated construction completion date at time of authorization	Construction schedule: Actual construction completion date	Operating costs: Estimated annual operating cost at time of authorization	Operating costs: Actual annual operating costs	Operating costs: Estimated future operating costs	Facility life: Expected useful life of the facility in LMFBR program	Facility life: Estimated useful life at time of authorization	Program area(s)	Statement of facility's contribution to the program
7. Zero Power Reactors 6 and 9 (ZPR 6&9)	ANL	100%	(b)	$ 3,000,000	$ 2,982,000	[k]$ 2,067,000	1958	1958	1961	1965	(b)	(j)	(j)	Through FY 1980	(b)	Reactor physics	Same as ZPPR
8. Alkalai Metal Cleaning Facility	HEDL	100	Under construction	850,000	1,120,000 (Current estimate)	-	1973	(b)	1974	1975 (Current estimate)	(b)	(l)	(b)	20 years	(m)	Component development	A cleaneing facility in the High Temperature Sodium Facility which will be used for development of maintenance procedures for sodium-wetted components.
9. Fast Flux Test Facility (FFTF)	HEDL	100	Under construction	87,500,000	[n]420,000,000	-	1967	1970	1973	[n]1977 (Current estimate)	(b)	(l)	$2,500,000 per year	1995 and beyond	(b)	Fuels and material, and plant experience	Provides highest performance and largest fuel testing capability in the world, providing a multiplicity of test positions. In design, construction, and operation serves as vehicle for developing larger component engineering technology.
10. High Temperature Sodium Facility (HTSF)	HEDL	100	1973	6,300,000	8,850,000	-	1970	1970	1972	1973	350,000	(b)	(b)	about 20 years	(m)	Component development	Testing reactor core components in sodium and development of operational and maintenance procedures for sodium-wetted components
11. LMFBR Fuel Pilot Fabrication Line	HEDL	90	1970	(b)	(b)	-	1969	(b)	(b)	(b)	(b)	(b)	(b)	10 years	(b)	Fuels and materials	Develop, demonstrate, and optimize process, techniques and equipment for fabricating fuels.
12. Shielded Material Facility (SMF)	HEDL	90	1966	(b)	(b)	-	1961	(b)	(b)	(b)	(b)	(b)	(b)	20 years	(b)	Fuels and materials	Nondestructive examination and testing irradiated reactor fuels and structural materials.
13. Components Handling and Cleaning Facility	LMEC	100	1975	2,000,000	2,380,000	-	1972	1973	1973	1975	(b)	(l)	(b)	10 years	10 years	Component development	Provides capability for handling large sodium-wetted components, removing sodium, and inspecting and repairing.
14. Large Leak Test Rig (LLTR)	LMEC	100	Under construction	3,000,000	3,000,000 (Current estimate)	-	1973	(b)	(b)	1975 (Current estimate)	(b)	(l)	(b)	3 years	3 years	Component development	Provides data on large water sodium leaks, adequacy of relief systems and capability of systems to withstand consequences.

CURRENT LMFBR PROGRAM
SUPPORT FACILITIES

				Facility costs			Construction schedule				Operating costs			Facility life			
Name of LMFBR support facility	Location	Relative use in support of LMFBR program	Date facility began operations	Estimated cost at time of authorization	Actual cost to construct facility	Amount costed on subsequent changes through 8/74	Date facility authorized	Date construction started	Estimated construction completion date at time of authorization	Actual construction completion date	Estimated annual operating cost at time of authorization	Actual annual operating costs	Estimated future operating costs	Expected useful life of the facility in LMFBR program	Estimated useful life at time of authorization	Program area(s)	Statement of facility's contribution to the program
15. Small Component Test Installation (SCTI) and Expansions	LMEC	100%	pre-1967	(b)	$11,938,000	-	pre-1967	(b)	(b)	pre-1967	(b)	(b)	(b)	10-year and 2- to 3-year test article	10-year and 2- to 3-year test article	Component development	Testing sodium-heated steam generators, sodium-to-sodium heat exchangers, sodium-to-air heat exchangers, and various in-line components and instrumentation.
16. Small Components Test Loop (SCTL)	LMEC	100	1974	(b)	1,620,000	-	1969	(b)	(b)	1974	(b)	(1)	(b)	10 years	10 years	Component development	Testing of components and instrumentation in sodium, including thermal shock testing.
17. Sodium Pump Test Facility (SPTF)	LMEC	100	Under construction	$6,800,000	[o]17,500,000 (Current estimate)	(b)	1967	1968	1969	1975 (Current estimate)	(b)	(1)	(b)	10 years	10 years	Component development	Hydraulic and thermal treatment testing of fuel size sodium mechanical pumps.
18. Transient Test Facility (TTF)	LMEC	100	To begin in 1976	4,000,000	(b)	-	1975	(b)	1976	1976 (Current estimate)	$500,000	(1)	$ 500,000	15 years	15 years	Component development	Investigates effect of thermal transients on performance of valves, tees, and other components and fittings.
19. Fuel Failure Mockup (FFM)	HNL	100	1971	(b)	[p]297,000	$ 140,515	1969	(b)	(b)	(b)	(b)	(b)	(b)	At least 2 years	-	Safety	Investigates thermal hydraulics of fuel subassemblies as related to failure and failure propagation.
20. Oak Ridge Electron Linear Accelerator (ORELA)	HNL	50	1968	4,800,000	4,800,000	200,000	1966	1966	1967	1971	(b)	(b)	(b)	At least 5 years	-	Reactor physics	Measurement of neutron cross sections and LMFBR materials.
21. Tower Shielding Facility (TSF)	HNL	80	1954	(b)	[p]3,083,000	250,000	1953	1953	1954	1954	(b)	(b)	(b)	20 years	-	Reactor physics	Provides integral reactor shielding design data and verification of shielding design parameters.
22. Clinch River Breeder Reactor (note q)	Clinch River, Tennessee	100	1982 (Current estimate)	448,000,000 (1972 estimate)	1,202,000,000 (Current estimate)	(1)	1969	Not yet begun	-	1982 (Current estimate)	57,000,000 (Total for first 5 years)	(1)	100,000,000 (Total for first 5 years)	-	-	Plant experience	Demonstration of LMFBR safety, reliability, operability, availability, maintainability, flexibility, inspectability, environmental acceptability, and prospects for economy.

FOOTNOTES

[a]Includes fuel cycle facility - HFEF/S.

[b]Not readily available.

[c]Does not include operations cost for HFEF/S; see footnote e.

[d]Completion of construction of HFEF/N slipped from the first quarter of 1971 to the last quarter of 1971 because construction funds were released 1 year after the date expected.

[e]HFEF/N operations costs are not specifically identifiable but rather are combined with HFEF/S costs. The costs represented here are the combined costs for these two facilities.

[f]Specific amount was not readily available as it was included as part of a $10 million Fuel Technology Center.

[g]Not available.

[h]Cost of operations for this facility are not identifiable as they are included in a multiactivity type of operation

[i]TREAT Operating Costs

TREAT Operating Costs	FY 73 (actual)	FY 74 (actual)	FY 75 (estimate)	FY 76 (estimate)
Cost of operations	$ 952,000	$1,739,000	$2,082,000	$3,760,000
Cost of experiments using the facility	3,203,000	3,699,000	3,500,000	5,216,000
Total	$4,155,000	$5,438,000	$5,582,000	$8,976,000

[j]ZPPR, ZPR-6, ZPR-9, and other costs are intermingled within the Fast Critical Facilities costs and, therefore, are not individually identifiable by AEC.

[k]Includes portion of Fast Neutron Generator cost.

[l]Not applicable.

[m]Cannot be determined at this time.

FOOTNOTES (cont'd.)

[n] The FFTF contractor is presently forecasting that an additional $92 million will be needed for construction of FFTF and that construction will be completed in August 1978.

[o] AEC is presently planning modification to the SPTF so it can accept Clinch River Breeder Reactor pumps for testing. These modifications are planned to begin in fiscal year 1978 and are estimated to cost $40 million.

[p] Figure represents gross book value of facility as of June 30, 1974.

[q] The Clinch River Breeder Reactor is a cooperative government/industry effort. The total project cost is presently estimated at $1.736 billion versus the initial estimate of $699 million. These costs include development and operating costs and escalation, as follows:

	Initial Estimate (1972)	Current Estimate (1974)
	(millions of dollars)	
Plant investment	$448	$1202
Development cost	194	434
Operating cost (5 year)	57	100
Total project cost	$699	$1736
Escalation	159	498
Total project cost (less escalation)	$540	$1238

Of the total project cost of $1.736 billion, AEC is expected to contribute $1.468 billion and industry $268 million.

PLANNED LMFBR PROGRAM SUPPORT FACILITIES

Name of LMFBR support facility	Location	Planned use of facility in support of the LMFBR program	Date facility is to be authorized	Date facility is to begin operations	Estimated completion date at time of actual or planned authorization	Amount of any major changes to the planned cost of the facility	Estimated operating cost of facility	Total estimated cost of facility (note a)	Program area(s)	Statement of facility's contribution to the program
1. High Performance Fuel Laboratory	HEDL	80%	FY 77	Late CY 81 or early CY 82	FY 82	(b)	(c)	$ 54,000,000	Fuel recycle	Fabrication facility for LMFBR test fuel assemblies replacing existing facilities which cannot adequately serve the program. It will provide the technological base for the design and operation of economic high production licensable commercial plants.
2. Plant Component Test Facility (PCTF)	LMEC	100	FY 77	(c)	(c)	(b)	(c)	200,000,000	Component development	PCTF is a key facility in the revised LMFBR program which will substitute component testing in the PCTF for construction of one or two additional demonstration plants after the Clinch River Breeder Reactor (CRBR).
3. LMFBR Fuels and Materials Examination Facility	(c)	100	FY 78	FY 82	FY 81	(c)	(c)	50,000,000	Fuels and materials	Facility will be used to examine large numbers of fuel and materials subassemblies and pins of the size irradiated in FFTF and CRBR.
4. LMFBR Fuels Reprocessing Hot Pilot Plant Storage Facility	(c)	100	FY 78	FY 81	FY 81	(b)	$ 3,000,000 a year	100,000,000	Fuel recycle	Facility will be used to store spent fuel before demonstration recovery runs in Experimental Reprocessing Facility which will also be used for CRBR fuels and possibly Near Commercial Breeder Reactor fuels.
5. LMFBR Fuels Reprocessing Hot Pilot Plant Experimental Reprocessing Facility	(c)	100	FY 79	FY 85	FY 84	(b)	10,000,000 a year	200,000,000	Fuel recycle	This facility is to test the new technology in hot pilot plant operations to reduce uncertainties to an acceptable level to insure process and equipment reliability and commercial applicability and to provide the operating experience which will build industrial confidence in the technology and enhance its acceptance.
6. Near Commercial Breeder Reactor (NCBR) (note d)	(c)	100	FY 77	(c)	FY 86	(c)	(c)	300,000,000	Plant experience	This facility is intended to provide industry with experience in designing, contracting, and operating commercial-size LMFBR powerplants.

APPENDIX V

PLANNED LMFBR PROGRAM SUPPORT FACILITIES

Name of LMFBR support facility	Location	Planned use of facility in support of the LMFBR program	Date facility is to be authorized	Date facility is to begin operations	Estimated completion date at time of actual or planned authorization	Amount of any major changes to the planned cost of the facility	Estimated operating cost of facility	Total estimated cost of facility (note a)	Program area(s)	Statement of facility's contribution to the program
7. Radiation and Repair Engineering Facility	(c)	100%	FY 78	(c)	About 5 years after authorization	Changes being contemplated though no dollar figure can be set at this time	(c)	$ 36,000,000	Component development	To provide a facility for decontaminating, removing sodium, and repairing radioactive components.
8. Safety Research Experiment Facility	(c)	100	FY 77	Mid-1980s	(c)	(c)	(c)	230,000,000	Safety	Facility will extend the spectrum of conditions achievable by current facilities to a range which will enable data to be developed to address outstanding safety issues. It will also provide flexibility for performing additional experiments which are at this time defined in a generic manner. It will provide input into the design evaluation process of commercial LMFBR designs and provide data to respond to concerns expressed by licensing bodies and citizen groups. Irradiation testing of fuel pins is to be done under prototypic conditions and power transient conditions typical of hypothesized accidents.

[a] These are planning estimates. According to ERDA, firmer estimates are being developed for authorization purposes.

[b] None.

[c] Not yet determined.

[d] NCBR is going to be a cooperative government/industry venture with the government contributing about $300,000,000 to the total cost of the project. This is a rough estimate on the part of ERDA and is identified by them as being somewhat below their expected contribution.

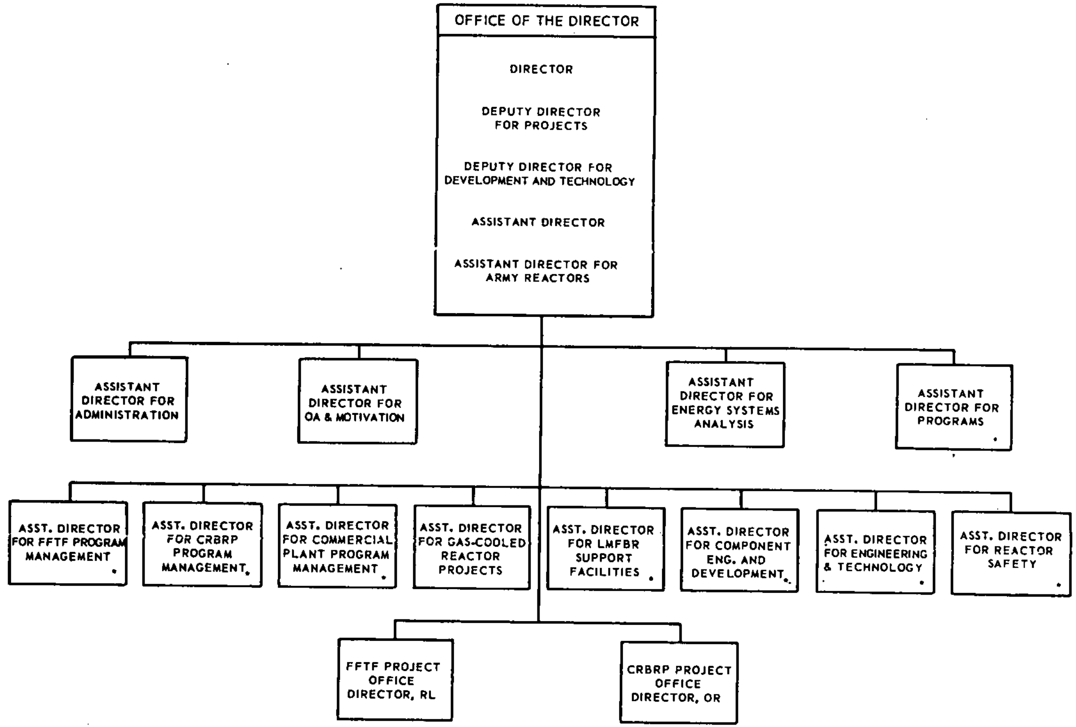
APPENDIX V

OTHER FACILITIES INVOLVED IN THE LMFBR PROGRAM

In addition to those facilities already presented, many others have been involved in the support of the development of the LMFBR program. These have been involved to varying degrees and are generally less significant in terms of overall program contribution than those shown on the previous pages. Some of these are shown below

Name of facility	Location	Status	Program Area
Experimental Breeder Reactor-I	INEL	Retired	Plant experience
Southwest Experimental Fast Oxide Reactor	Fayetteville, Arkansas	Retired	Plant experience
Sodium Loop Safety Facility	INEL	Under construction	Safety
Pump Seal Test Facility	LMEC	Operating	Component development
Transient Test Loop	HEDL	Operating	Component development
Out-of-Pile Expulsion and Re-entry Apparatus	ANL	Operating	Safety
Argonne Fast Source Reactor	ANL	Operating	Reactor physics
Core Component Test Loop	ANL	Operating	Component development
Special Environmental Radiometallurgy Facility	HEDL	Operating	Fuels and materials
Large Components Test Loop	LMEC	Retired	Component development
Small Component Evaluation Loop	HEDL	Operating	Component development
Hot cells	Various	Operating	Fuels and materials

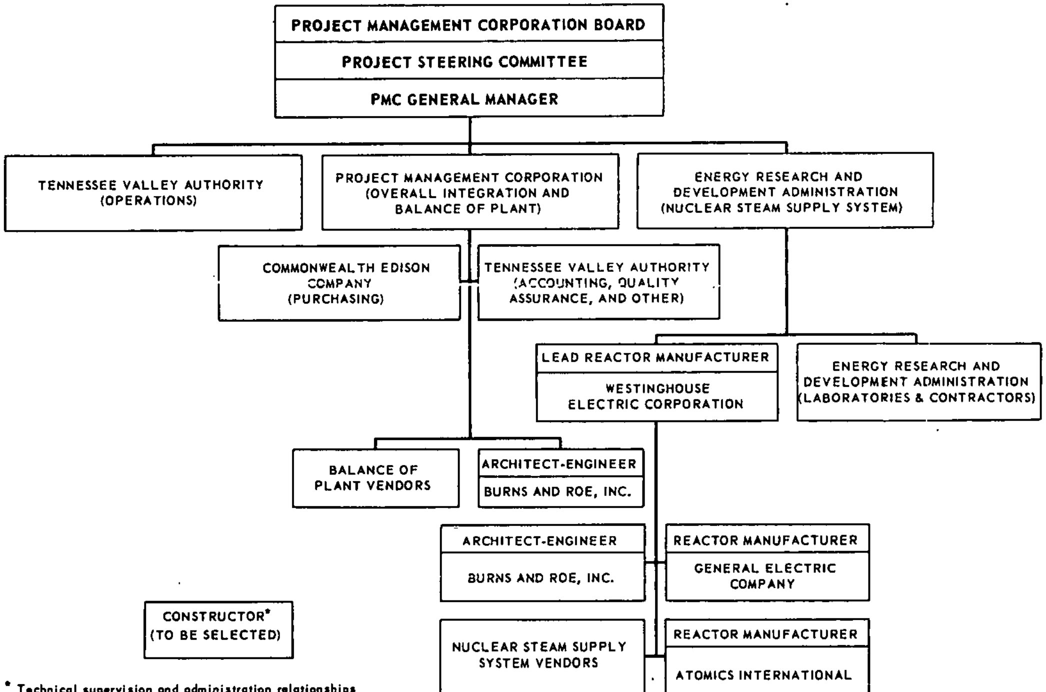
REACTOR RESEARCH AND DEVELOPMENT DIVISION



* Assistant Directors involved in the LMFBR program.

APPENDIX VI

CRBR PROJECT MANAGEMENT ORGANIZATION CHART



* Technical supervision and administration relationships will be established later.

APPENDIX VII

PRINCIPAL OFFICIALS OF AEC AND ERDA RESPONSIBLE FOR ADMINISTERING THE ACTIVITIES DISCUSSED IN THIS REPORT

	Tenure of office From	To
AEC		
Chairman:		
Dixy Lee Ray	Feb. 1973	Jan. 1975
James R. Schlesinger	Aug. 1971	Feb. 1973
Glenn T. Seaborg	Mar. 1961	Aug. 1971
General Manager:		
Robert D. Thorne (acting)	Jan. 1975	Jan. 1975
John A. Erlewine	Jan. 1974	Dec. 1974
Robert E. Hollingsworth	Aug. 1964	Jan. 1974
ERDA		
Administrator:		
Robert C. Seamans, Jr.	Jan. 1975	Present
Assistant Administrator for Nuclear Energy:		
Robert D. Thorne (acting deputy)	Jan. 1975	Present

Chairman HUMPHREY. We will conduct a second day of hearings on the breeder reactor program on Thursday, May 8, at 9 a.m. We will announce the room. We have had some difficulties with our room assignments. The Joint Economic Committee, which has been established since 1947, has been a migrant. It has never yet had its own space. Congress provides space for subcommittees that have little or nothing to do with the common good, but it finds no way to provide space for a committee that has the responsibility under public law to examine and evaluate economic forces and pressures that may affect the very well-being and life of this Republic. But, that is not unusual. The Congress, at times, doesn't get its priorities straightened out. Well, that was a little aside.

Representative BOLLING. I should say I agree with that.

Chairman HUMPHREY. Thanks for the amen.

On May 8, we will have Robert Seamans of the Energy Research and Development Agency, followed by Mr. Ralph Nader and Mr. John Simpson, a director of Westinghouse; and Mr. Thomas Cochran of the Natural Resources Defense Council; and finally, Mr. Thomas Stauffer from Harvard University.

On Thursday, May 8, according to the latest bulletin, subject to innumerable changes, we will be in room 318 of the Russell Senate Office Building. God willing, and the Sergeant at Arms and the chairman of other committees willing, and hopefully, with a lot of luck, we will have the hearing in that room.

Now, I thank you for being able to keep up with these room changes, Mr. Staats, and for coming to the right place this morning. I wasn't quite sure myself, but here we are, and we welcome your statement and your participation.

STATEMENT OF HON. ELMER B. STAATS, COMPTROLLER GENERAL OF THE UNITED STATES, ACCOMPANIED BY HENRY ESCHWEGE, DIRECTOR, RESOURCES AND ECONOMIC DEVELOPMENT DIVISION; RALPH CARLONE, ASSISTANT DIRECTOR; AND PHILLIP S. HUGHES, ASSISTANT COMPTROLLER GENERAL, GENERAL SERVICES ADMINISTRATION

Mr. STAATS. Thank you very much. Before starting I would like to introduce my other two colleagues. In addition to Mr. Hughes here, we have Mr. Henry Eschwege at the end of the table, who is the head of our Resources and Economic Development Division; and Mr. Carlone here, who has done a great deal of work on the report you referred to and is one of Mr. Eschwege's associates.

Chairman HUMPHREY. We welcome them and are delighted to see them. Through my mind flashed several studies I wanted to ask of both of you, so I am particularly delighted to see you.

Mr. STAATS. As you have already indicated, our testimony this morning has to do with the liquid metal fast breeder reactor program, which is the subject of our recent report and represents the highest priority energy research and development program of our Nation.

Over the past year congressional and public interest in this program has intensified. The program's total estimated cost and the amount of Federal funds expected to be spent on it have increased. As the program gained in importance, we in the General Accounting Office devoted additional resources to reviewing its many facets as part of our office-wide effort to examine the Nation's response to the energy crisis.

I would like to depart from my text for a second to say we have accorded energy programs the highest priority in our total work program in the GAO, followed closely behind by food and fiber and by materials.

Chairman HUMPHREY. What was the third?

Mr. STAATS. Pardon.

Chairman HUMPHREY. What was the third?

Mr. STAATS. Materials, raw materials?

Chairman HUMPHREY. Materials? Nice to have some agency of Government that has its priorities properly arranged.

Mr. STAATS. During the past 6 months we issued staff studies on ERDA's fast-flux test facility and on certain problems which could affect the development schedule for the Clinch River breeder reactor.

Chairman HUMPHREY. Would you identify these? You say the fast-flux test facility. Where and what is that?

Mr. STAATS. Do you want to answer that, Mr. Carlone?

Mr. CARLONE. It is a facility for testing fuels and materials and it is being built at the Hanford Engineering Laboratory, Richland, Wash.

Chairman HUMPHREY. All right, and the Clinch River breeder reactor?

Mr. CARLONE. It is the first liquid metal fast breeder reactor demonstration plant, and it is being built near Oak Ridge, Tenn.

Chairman HUMPHREY. When does it start?

Mr. CARLONE. It hasn't started yet. It is an R. & D. effort. The actual construction hasn't started.

Chairman HUMPHREY. The authorization was when?

Mr. CARLONE. Congress initially authorized the project—Public Law 91–273 as amended—in 1970. This is a joint government/industry demonstration project.

Chairman HUMPHREY. Right, I just wanted to pinpoint that for our record.

Mr. STAATS. The fast flux test facility is a key testing facility for fuels and materials in the breeder program. The Clinch River breeder reactor is scheduled to this Nation's first demonstration project to help show the value of the breeder concept. In addition we recently provided the Joint Committee on Atomic Energy our comments on ERDA's proposed arrangement for managing the Clinch River breeder reactor demonstration plant project.

In May, we plan to release a report on the cost and schedule estimates for the first breeder demonstration plant, and fairly soon thereafter an issue paper on the broad range of promises and uncertainties of the total breeder program—the need for the program, the potential benefits to be realized from it, and risks associated with commercial use of this type of energy.

I should say here, Mr. Chairman, it is not our present intent to recommend for or against the program in this issue paper. Our issue paper, which we refer to here, has as its purpose to develop the issues and the questions which we believe would be useful to help Congress come to some conclusion with respect to this very important program.

Chairman HUMPHREY. And that will be available to us next month? Is that right?

Mr. STAATS. We hope it will be. We are doing a great deal of work on it. It is a very difficult paper, but that is our present intention.

Earlier this week, we submitted a comprehensive report to the Congress on how the breeder program started, where it is today, and current plans for its future operation. I would like to discuss today some of the highlights of that report. The remainder of my testimony will be largely a summary or highlight of that report.

Chairman HUMPHREY. Might I just interrupt at this time? I don't know whether I made it clear before, but we are not trying, in any way, to preempt the overall jurisdiction of the Joint Committee on Atomic Energy which has the basic responsibility for this program. We are looking essentially at cost and economic items, at the cost-benefit ratio and the possibilities of cost-overruns. The economics of the program, in other words, is what we are concerned with. I say this so that the record may be clear. We have discussed this with certain members of the Joint Committee on Atomic Energy.

Mr. STAATS. The basic objective of the liquid metal fast breeder reactor program is to develop a broad technological and engineering base with extensive utility and industrial involvement which will lead to a strong, competitive commercial breeder industry. Commercialization of breeders has been proceeding along two lines of effort—the base technology program and the demonstration plant program. Under the base technology program, emphasis is placed on developing key technical areas. This part of the program includes engineering develoment, manufacturing, and equipment testing efforts.

The demonstration plant program is the key to the program's transition from the technology development phase to large-scale commercial utilization. Plans for building the Clinch River breeder reactor near Oak Ridge, Tenn., are now in the preliminary design stages. This facility is to be a 350-megawatt electric powerplant and is presently scheduled to be operational by mid-1982. It is a cooperative government/industry effort.

Until recently, the breeder program stressed the progressive development of six successively larger demonstration plants. This approach would have required considerable government support to develop larger components for each successive demonstration plant. In mid-1974, the Atomic Energy Commission (AEC)—the predecessor agency to ERDA—realized that this approach placed too much emphasis on plant construction and operation, and not enough on developing plant components. Consequently, AEC terminated plans for all but one demonstration plant and decided to build instead a facility to test large components. This major redirection places the Clinch River plant in a very important position.

ERDA envisions that operation of the first large commercial breeder will begin in 1987—a target date which has slipped 3 years since 1969. ERDA has projected that 186 commercial-sized breeders will be built and in operation by the year 2000. There are indications from the private sector, however, that these projections are optimistic and possibly unrealistic.

PROGRAM COSTS

Total program expenditures from fiscal year 1948 through fiscal year 1974 were $1.8 billion. Recent estimates show that an additional $8.9 billion will be needed to carry the program through the year 2020 indicating a total program cost of $10.7 billion—an increase of about $6.8 billion in estimated costs since 1968. It should be noted that the additional $8.9 billion does not include the effects of any inflation after fiscal year 1976.

Chairman HUMPHREY. Who made that estimate?

Mr. STAATS. This is ERDA's estimate.

Chairman HUMPHREY. They ignored the factor of inflation?

Mr. STAATS. The next sentence here explains it, Mr. Chairman.

Chairman HUMPHREY. Oh, I see.

Mr. STAATS. This is in accordance with a long-established Office of Management and Budget policy, which requires Federal agencies to make all estimates of the costs and benefits of programs in constant dollars for each year of the planning period.

I would like to digress here to say that our office on inumerable occasions has questioned this policy. We believe that the agency that is asking for the funds is in the best possible position to make an estimate or range of possible growth in cost due to inflation, because you cannot just take a projection of the general economy and apply that to a particular program. So that we feel on major weapons systems, or programs of that type, which are highly specialized in nature, that we cannot make a projection just based on general economy-wide forecasts of inflation. We should be giving Congress better information with respect to potential cost growth due to the factors of inflation and scarcity and so on.

The $10.7 billion estimate includes $300 million for providing a Government subsidy to one additional demonstration plant, the so-called near commercial breeder reactor, to be constructed after completion of the Clinch River demonstration plant. ERDA and its contractors have estimated that this subsidy could go as high as $2 billion for several plants if the program does not attain its development goals. Aside from Federal funds going into the plant, about $½ billion are expected to be spent by private industry over the next 5 to 10 years to develop the breeder and build the Clinch River breeder reactor.

Federal energy research and development has grown markedly from fiscal year 1971 when it was $420 million to an estimated $1.8 billion for fiscal year 1976. Federal funding for developing the breeder was $168 million for fiscal year 1971, about 40 percent of that year's total Federal energy research and development funding. In fiscal year 1976, funding for the breeder is expected to be $474 million, about 26 percent of total Federal energy research and development funding.

ELEMENTS AND FACILITIES MAKING UP THE PROGRAM

The breeder program consists of six major program areas, each of which contributes an important element of technology. The six areas are reactor physics, fuels and materials, fuel recycle, safety, component development, and plant experience. Each area has at least one major test or demonstration facility which is to contribute significantly to the objective of commercializing the breeder.

We identified 22 major facilities in use or being built in support of the program. There are plans to build eight more major facilities. The estimated cost of all of these facilities is about $3 billion or almost 30 percent of the total program costs. Three of the most important facilities have experienced large cost increases and schedule delays. For example the fast flux test facility, originally estimated in 1967 to cost $87.5 million and to begin operations early in 1974, is now forecast to cost $512 million, and operations are not expected to begin until early in 1980.

Estimated costs for the Clinch River demonstration plant itself have increased from $699 million to $1.7 billion over the last 2 years, and the scheduled startup has slipped from 1980 to 1982. The sodium pump test facility, a facility for testing breeder pumps, originally estimated in 1966 to cost $6.8 million, is presently estimated to cost $17.5 million. ERDA is planning to modify this facility so it can test pumps for the Clinch River Breeder Reactor. These modifications, which are planned to begin in fiscal year 1978, are currently estimated to cost $40 million, thereby increasing the project's total cost to $57.5 million.

CONTINUED AVAILABILITY OF QUALIFIED FUEL FABRICATORS

Private industry's involvement in the developmental stages of the LMFBR program is essential for meeting the program objective of establishing a timely capability for a commercially competitive breeder program. Within the fuels and materials area, there is a potential problem concernng the continued availability of qualified fabricators of breeder fuel.

In 1972, AEC awarded fixed-price contracts to two companies to fabricate fuel for the first two fast flux test facility reactor cores. Based on current projections, both fabricators will complete production between June and August of 1975. According to ERDA, the only other market for such fuel in the next several years will be the Clinch River project. Without follow-on fuel fabrication work after mid-1975, the current production facilities or both these contractors can be expected to shut down, and it is uncertain if these facilities could or would become operational again when needed several years later. There is a strong possibility, therefore, that the capability of one or both contractors will be lost to the program with a consequent loss of assurance that the certain, near-term fuel needs of the fast flux test facility and the Clinch River plant can be met.

To maintain a capability in private industry to fabricate breeder fuel, ERDA plans within a few months to select one of the two contractors to fabricate two additional cores for future use in the fast flux test facility. It is anticipated that his approach will allow one contractor to continue operations until about mid-1978. ERDA is relying on the break-in operations between completion of fast flux test facility work and beginning of Clinch River work to be short enough for the supplier to continue in business.

FUEL RECYCLE AREA—LEAST ADVANCED

The ability to recycle plutonium for use in the breeder is essential to the breeder concept. This ability—fuel recycling—is probably the least technologically advanced area at this time. The Nuclear Regulatory Commission is presently considering the question of allowing recycling of plutominum for use as fuel in light-water reactors. A decision is expected in late 1977 or early 1978. The Commission's decision regarding plutonium recycling for light-water reactors will be significant to the breeder program since the health, safety, and safeguard implications of using plutonium are similar for both types of reactors.

MANAGEMENT OF THE BREEDER PROGRAM

The ERDA division managing the breeder program experienced delays in reaching agreement on programing and technical matters affecting the program. The agency is currently implementing a new system for administering, managing, and controlling its various programs, of which the breeder program is the most important. This new management control system holds promise for providing greater program visibility and a stronger management focus on those areas of the program experiencing problems.

The demonstration project is managed jointly by ERDA and its utility industry participants. This management arrangement is complex and potentially cumbersome. On March 10, 1975, ERDA submitted to the Joint Committee on Atomic Energy for its consideration proposed legislation for a new management structure for the project. Management control would be given to ERDA to strengthen and streamline the Government's control over the project to correspond with the Government's investment in the project—now estimated at about $1.5 billion. In our report to the Joint Committee on Atomic Energy earlier this month, we pointed out that the ERDA proposal did not clearly delineate the manner in which the project would be managed and that ERDA might not be able to exercise usual management prerogatives.

Let me say we submitted the report at the request of the Joint Committee to comment on this proposed arrangement.

FOREIGN BREEDER PROGRAMS

Developing a liquid metal fast breeder reactor is a high-priority national energy program of five other major industrial nations: The United Kingdom, France, Japan, West Germany, and the Soviet Union. ERDA believes that, of the foreign programs, the Soviet Union and France are probably the most advanced in reactor development. The United Kingdom, France, and the Soviet Union already have demonstration-size breeders in operation. Although there are some differences between the U.S. and foreign programs, all foreign programs are aimed ultimately at commercial-size plants in the thousand-megawatt range or greater. Also, these programs include the construction of intermediate size plants.

An ERDA review group reported that foreign breeder programs can contribute important data and information to the U.S. program, but the United States could not save any large amount of effort by using the foreign programs.

In order for the Congress to know whether greater reliance can be placed on the use of foreign breeder technology, we are suggesting that the Congress explore in greater depth with ERDA the advantages and disadvantages of using foreign breeder technology.

In conclusion, Mr. Chairman, I want to point out that the ERDA Administrator is currently reviewing the plans for the breeder as part of an energy development plan which will be submitted to the Congress by June 30, 1975. Thus, existing plans for the breeder program are subject to change both as to schedule and cost.

I would like to add here, Mr. Chairman, that we have had excellent cooperation from ERDA in terms of supplying us information and meeting with us and commenting on our draft report, and other ways that we operate with them.

This concludes our statement. Mr. Hughes, Mr. Eschwege, and Mr. Carlone will be able to respond to some of your questions. I don't personally have as many of the details as I would like, but we will do the best we can.

Chairman HUMPHREY. Mr. Carlone, do you have anything you would like to add, since you were so deeply involved in the preparation of the overall report?

Mr. CARLONE. No, sir.

Chairman HUMPHREY. Does anyone else of your team here?

Mr. HUGHES. I don't have anything to add, Mr. Chairman.

Chairman HUMPHREY. Well, we will proceed with some of the questions by the staff of the Joint Economic Committee, those that have been assigned to this project. They have read your report very carefully, and we want to refer to it for some questions.

As I understand it, the one recommendation which your report has made is the one, which you referred to in the concluding remarks of your statement, namely, that for the Congress to know whether greater reliance can be placed on foreign breeder technology you propose for Congress to explore in greater depth with ERDA the advantages and disadvantages of using foreign developments. Is that correct?

Mr. STAATS. That is correct. We think that one of the options that might be open to us is to take greater advantage of foreign technology. There are obviously some difficulties and disadvantages. It is a question of weighing those in relationship to the time required to go ahead with our own program. There are elements of safety involved here, elements of health, the balance of payments, a question of patent rights, component availability problems and many other considerations, as was pointed out in the report. But they still represent a policy issue which needs further exploration, as we see it.

Chairman HUMPHREY. Has your staff, Mr. Staats, for instance, Mr. Carlone, have you examined this foreign breeder technology?

Mr. CARLONE. No, sir, nothing more than finding out from ERDA the status of the foreign programs. We chose to do this because of the time limitations. We wanted to get the results of our review to the Congress as soon as possible for their consideration.

Chairman HUMPHREY. May I respectfully suggest, in light of the fact that you have emphasized this as the major recommendation in this report, that you assign somebody to look into the foreign breeder programs? Because you say here that the United Kingdom, France, and the Soviet Union already have demonstration-sized breeders in operation.

Do we have demonstration-sized breeders in operation?

Mr. CARLONE. No, sir.

Chairman HUMPHREY. All right.

Mr. CARLONE. The CRBR will be this Nation's first demonstration project?

Chairman HUMPHREY. That is correct, but there are demonstration-sized breeders in operation in three other countries, right?

Mr. CARLONE. Yes, sir.

Chairman HUMPHREY. I think it is incumbent upon you to give us an additional report on what these countries are finding out about that technology and the cost-benefit relationship that they seem to have found.

Mr. HUGHES. Mr. Chairman, if I could comment? We expect to have some more things to say in our forthcoming report on general issues about the breeder. As Mr. Staats indicated, the questions involved are quite complex and many of them, I think, are of particular concern to this committee, like balance of payments questions, and so on.

Chairman HUMPHREY. Right.

Mr. HUGHES. One of the alleged significant differences between what we are planning for the Clinch River breeder and some of the overseas developments has to do with the safety and environmental features, and I think this too is an area that can be profitably looked at by those who are qualified to do so.

Chairman HUMPHREY. Yes. I recognize the difficulties and the complexities of it. I think there are certain questions that we have to ask ourselves, though, in light of the advances some of these countries have already made. Are there component parts, for example, that one could obtain from abroad? Is there any way that we might avoid duplication?

Mr. HUGHES. We will be dealing with some of these questions and I hope all of the major ones in our issue paper, in some depth, and I hope those comments will be helpful to you.

Chairman HUMPHREY. Well, I just want to make it clear that I think the GAO should feel, as a result of this testimony, that a much more in-depth study should be made of foreign developments in this area. ERDA will be making an analysis, but ERDA is an executive agency. ERDA is highly nuclear-oriented.

I want a fully objective analysis made from the General Accounting Office's point of view. It may come out exactly the same way. It is just a matter of doublechecking here.

I realize there are economic problems, such as the balance-of-payments problem and trade problems and so forth, but I just came back from a visit in Europe in April where we were talking about standardization of aircraft, for example, which is often a nice way of saying "Buy American," but not always. Sometimes we buy from somebody else. Anyway, I want you to look at it. Not that it will give us any definitive information, but it gives us some comparative information.

Mr. STAATS. I think the Congress is entitled to two points of view. As you say, we may come out exactly the same way. It has been said, and probably accurately, that the French reactor could not be licensed in the United States because of the safety and environmental considerations that we would insist upon, which apparently they do not.

Chairman HUMPHREY. Well, I think it would be interesting to know.

Mr. STAATS. But that would be the kind of issue which could stand some airing, and also the point that you alluded to about whether some of the research and maybe some of the components could be used in our program to our advantage and possibly to their advantage.

Chairman HUMPHREY. On the environmental side, I think, that the French have done a better job taking care of their countryside than we have, having traveled through that grand Republic. You know, they have been there a long time, and when you take a look at their forests and go on over and take a look in Germany at some of the strip mining they have done and how they have taken care of the land, well, I don't think we have that much to talk about in terms of the environment. If the French think it is environmentally sound, I would be somewhat impressed, as I would if the Germans did, because our record of environmental concern is beer cans in the ditch, paper on the streets, smoke in the skies, and fumes from exhaust pipes. Up until now, we haven't done much about it.

So, I just thought I would emphasize for you to look at these foreign projects because we have a tendency here to kind of pass that off like it never happened. I don't want us to do so here.

Mr. HUGHES. I think, Mr. Chairman, there has been a fair amount—in fact, a great deal of information exchange in the scientific community, both governmental and private, within these areas, or at least that is what we gather from those who are involved in the technological and scientific aspects of this. But I think some formalization of that could be very helpful.

Chairman HUMPHREY. Thank you, Mr. Staats, a decision to stretch out the breeder program, which is one of the options being talked about, would be a decision to slow its growth, to stabilize the program. It probably would not cut back or cut off the program—I say probably. And probably it would not disperse the existing personnel and expertise working on the program and would not create a hiatus in its development. I recognize, of course, that this conclusion is subject to some discusion and dispute.

The AEC originally planned, as you have indicated, six demonstration plants on the way to commercialization of the breeder. Recently this was reduced to two; is that correct?

Mr. CARLONE. Yes, including the Near Commercial breeder reactor.

Chairman HUMPHREY. Do you believe that the original program was poorly laid out, or are we sacrificing necessary steps by eliminating these other two demonstration plants?

Mr. CARLONE. I don't know that it was poorly laid out in the beginning. I think that as more information became available, they changed the emphasis of the program.

Mr. HUGHES. I think, Mr. Chairman, to an extent also the answer to your question is part of the controversy surrounding the development of the breeder. There are intensive debates which have to do with electricity demand on the one hand, and, with the supply of uranium on the other hand, and with the advisability of simultaneous development of the components—the more or less simultaneous development versus sequencing—and those things. But these are issues within the scientific community upon which informed persons argue. The key questions obviously are the demand question and the supply of uranium. Obviously, the answer to either question is somewhat speculative.

Chairman HUMPHREY. Yes; so that you are not quite prepared to say definitively whether we are sacrificing necessary steps?

Mr. HUGHES. It seems to me, Mr. Chairman, that in terms of safety and sureness, slowness is an advantage, up to a point at least. However, if, as some maintain, either the demand for uranium or the interaction between supply and demand is such that we haven't time, then we obviously have some very serious problems that we need to deal with. Some of the questions here are highly technical questions as to how sure we can be as we progress.

Chairman HUMPHREY. And that of course, as you indicated, is a very controversial point.

Mr. STAATS. There are obviously tradeoffs that are to be made in terms of time against certainty. The longer time draws out, then there is obviously a cost involved.

Chairman HUMPHREY. That is a point I wanted to ask. There would undoubtedly be increased costs if this were drawn out over a long period of time.

Mr. STAATS. I think so. Part of the interest of this issue paper is to point out these tradeoffs, Mr. Chairman, that we hope will be helpful to you.

Chairman HUMPHREY. Just to continue a little bit more on the foreign aspects here, because it was the recommendation that you brought to our attention, how do you account for the purported low cost of the French breeder reactor program when we are having such tremendous problems with the cost of ours, particularly these spectacular cost overruns that you indicated in your paper?

Mr. Carlone, do you want to refer to that?

Mr. CARLONE. We haven't seen the French estimated cost; we haven't been privy to their cost figures.

Chairman HUMPHREY. That is why I want you to look into it. Now, our staff here tells us that the French costs are much lower and their estimates have been much better. I just want to know what kind of forecasters we have in this Government? When I looked at some of these figures that you gave to us, it was startling. One that I remember particularly, if I might just take a minute of your time, was the sodium pump test facility, which had a jump from $6,800,000 to $57,500,000. You know that isn't even a good guess. Anybody that was throwing darts and went that far wrong might kill somebody.

Mr. HUGHES. I think, Mr. Chairman, the alleged explanations for the differences in cost between the French program and ours are in two categories: One has to do with the comparative management styles or management structures. It has been alleged that the French have done better in this regard than we have in terms of project management, of tightness of control and so on. That is an allegation as far as we are concerned.

The other area is the safety and environmental area, where again it is alleged that, in this country, the target or goal has been essentially a moving one, with standards rising. This has contributed significantly to cost escalation. It also is alleged, and I am inclined to agree with it, that our safety standards are somewhat more rigid and somewhat higher. That, in turn, has affected the total cost of the project.

Chairman HUMPHREY. Your list of problems associated with the use of the French technology includes some uncertainties of a technological nature, of which we surely have enough with our own program. Also, you mentioned some problems of meeting U.S. regulations and the loss of business to U.S. manufacturers and so on. This is in your report and not in your statement today.

But your report mentions no serious problems of a technological or economic nature. One might get the impression that people are fabricating problems to save the role of ERDA and U.S. industry at the expense to our taxpayers. Do you see any clear reason why we should not explore the possibility with the French and other foreign countries for sharing the work and expense of breeder development or for acquiring some of the needed technology from others?

Let me get to my point again. We've already got a big love thy neighbor project with the Soviet Union on space exploration going on right now wherein we share technology. I have a feeling we are giving a lot more to them than we are getting. That is just my judgment. It is probably a very parochial judgment, but nevertheless we are sharing.

We are always talking about cooperating with our Western allies. We've got all kinds of cooperative endeavors supposedly under way. Why isn't it possible to explore with these countries, particularly the ones that seem to have some advances in technology, the prospect for sharing in the work and expense of this project? Why can't we pool some of this? Apparently, there are several countries—I think you mentioned five countries—terribly interested in this right now.

Mr. STAATS. I think the answer is clearly we should explore it. These countries got started on building their demonstration-size breeder plants before we did.

Chairman HUMPHREY. But why? We are the mamma and papa of nuclear technology, aren't we?

Mr. STAATS. They have had more experience with this aspect of it. I am not sure I could answer why they got started on it earlier, except possibly that they foresaw the possibility that certain resources wouldn't be available to them, whereas we have had a relatively abundant outlook with respect to these resources.

Mr. CARLONE. I think it all goes back to their philosophy, as Mr. Hughes pointed out. In this country, we tried to develop the technological base first and then build the large reactors, whereas in the foreign programs there has been more emphasis towards building the large reactors first and seeing whether they will work, whether they can operate safely and then, as I understand it, doing some of the developmental work.

Chairman HUMPHREY. You see, this is my point. We've got to know more about this. I am suspicious here. I do not believe that the French are incompetent. I think they are very capable and technologically advanced people. I think our technology may be better. At least, I hope it is, but we can always learn from somebody else.

One of the needs here is to develop a common breeder design. They you would be able to increase competition in supply new components, which would be of benefit to all parties involved: The manufacturers, the developers of the components, as well as to the consumer and the taxpayer. And this is why I press you hard, as I am going to press ERDA and press everybody that comes up here hard, to see why we are not doing a little better job on international cooperation. We are always giving the world lectures on international cooperation. You know, are you ready to buy American, or can we send our Army over to your country? So I want to know why we are not cooperating in this endeavor. I want you to find out for us. Explore it in depth. Get the literature. Get the Library of Congress to work at it. Find out, because I am not sure that ERDA is going to find out. However we are going to have them up here and we are going to ask them the same question.

You know things are happening abroad. For example, the automobile industry in this country refused to develop an engine that would give us more fuel efficiency and finally the Japanese and Germans developed one. Now we are still talking about how we are going to develop one, like it is a great big secret. You know, it is about as secret as Life Savers and Spearmint gum.

And I think there is a reason for this lack of collaboration so far as the breeder is concerned. I think it is essentially a matter of trying to lock up the market so nobody else can get in. Now, your report contains only one remark under the heading, "Matters for Consideration of Congress." If we were to purchase breeders from the French for example, could we manufacture our own fuels so as to become independent of foreign supply sources? Do you know the answer to that one?

Mr. HUGHES. Senator, I think the general answer in laymen's terms is "Yes, we can." It seems to me that theoretically we can design fuel to meet the needs of the particular reactor if we are aware of those needs. We ought to be careful we don't lock ourselves into a technology or fuel source which puts us in the same position we are in vis-a-vis the oil-producing countries today. But there is no inherent reason why the use of foreign components or benefiting from the experimentation and research and developmental work they have done should lock us into a particular supply source or a particular supply type that we could not duplicate.

Chairman HUMPHREY. Have you ever seen British television?

Mr. HUGHES. No, sir.

Chairman HUMPHREY. Well, now, sometime, if you have the opportunity to travel to London, you take a look at British color television and then take a look at ours. You'll see the difference between a barn painter and a Picasso, and we are the barn painter. I mean, they've got the advanced technology there. Of course, we got in early with our patents and all, and we are locked into a much less precise type of television.

Mr. STAATS. That is true throughout Europe.

Chairman HUMPHREY. That is true. You know, I like to think we are first in everything, but once in a while you get out of the county seat and you find out that we are not.

I just want to be sure that the figures we are talking about here are correct. They are so staggering.

We are talking about a $10.7 billion project on an R. & D. basis between now and what is the year? Is it 1987?

Mr. STAATS. 2020.

Chairman HUMPHREY. And we are using figures that don't have any inflation.

Mr. STAATS. That is without any inflation beyond fiscal year 1976.

Chairman HUMPHREY. Well, you've really got to have great faith. I mean, that must be the greatest religious revival this country has ever had if we believe there will be no inflation.

Now, let's talk about one other question here. First, let me say I am extremely interested in this development and I don't want my questions to seem hostile. But, one of the reasons for my questions is so many things have changed of late because of the high cost of energy. For example, industry today is making use of energy much better. We are becoming less wasteful. Demand for electricity has slipped some, that is, compared to what was projected. The FEA has said that electricity demand growth has moderated.

Now, do you consider this a permanent moderation? Is this something that we should count on in the future or is it a temporary development?

Mr. HUGHES. Mr. Chairman, I will answer that. There are several factors to be considered in determining the growth of energy consumption. One of them is population growth, and to the extent that population growth modifies—and you know the pattern of growth is changing—then the growth in energy consumption will be affected.

The second point has to do with the price increases which you have referred to. It seems very likely, although I don't think anybody can measure the effect with precision, but it seems very likely that those price increases have effectively changed the trend in energy growth. As a matter of fact, I think in 1974 the use of energy declined for the first time in recorded history.

Chairman HUMPHREY. Well, that could be because of a recession.

Mr. HUGHES. Yes, and the third component is the general economic recession, which had a profound effect upon the country in 1974. I don't think anybody can sort out the separate effects of the price adjustment and the economic recession. We will have to wait and see, but there are general implications and I think generally accepted indications that the trend of energy growth is modifying from something around 4 percent of higher to something below—well, in the range of 2 to 3 percent per year. Now, that would be a rather marked change, but it is still a very significant growth rate over the long run, and one of the concerns of all of us is how you meet this need.

Chairman HUMPHREY. Then there is another factor to toss in here. There is some talk now with the lower supplies of natural gas that, regardless of price, there will be more use of electricity for home heating.

Yes. Mr. Staats?

Mr. STAATS. A great deal of that will depend, of course, on what kind of energy program eventually emerges from the Congress. We have been working closely with the House Ways and Means Committee and other committees in development of an energy program and, Senator, depending upon what kind of a program is developed by way of incentives to conserve energy, particularly in the next 10 years, this could be a very important factor.

Now, the package that we have developed, which is really not unlike the package that has been under consideration in the House Ways and Means Committee, we projected would result in an annual growth to 1984, I believe, of 1.9 percent a year. Now that compares with something over 4 percent, as Mr. Hughes has indicated.

Chairman HUMPHREY. Is that electricity or total use of energy?

Mr. STAATS. Total use of energy.

Chairman HUMPHREY. Congressman, do you have anything?

Representative HAMILTON. Thank you, Mr. Chairman. I apologize to you, Mr. Staats, for coming in late. Mr. Staats, I would like to get a general idea as to the proportion of the breeder reactor program cost that is being borne by the Government as opposed to the private sector. Can you give us some indication of this?

Mr. STAATS. Mr. Carlone will do this.

Representative HAMILTON. I recall a couple of Presidential messages that came to the Hill in which the emphasis was that industry should bear the major cost of the demonstration projects. We are talking about demonstration projects now and not the commercial plants. The Government was going to help on technological leadership and sharing some of the risks. How is that working out?

Mr. CARLONE. On the Clinch River breeder reactor, the industrial participation is about $270 million and, of course, it is limited to $270 million and the Government has the open-ended commitment.

Mr. HUGHES. That is $270 million out of a total of about $1.7 billion.

Mr. CARLONE. Right.

Representative HAMILTON. That $1.7 billion is for the Clinch River breeder reactor?

Mr. CARLONE. Yes.

Representative HAMILTON. For the Government and you say $270 million for the——

Mr. CARLONE. No, sir, the current estimate for the breeder reactor is $1.7 billion and of that the private sector will pay——

Repesentative HAMILTON. Will pay $270 million?

Mr. CARLONE. Right.

Representative HAMILTON. Now, is that kind of proportion the same with other aspects of the breeder reactor program? In other words, the Government is bearing the overwhelming proportion?

Mr. HUGHES. With respect to the research component, the bulk of the cost for that has been the Government's. There are another $240 million or $250 million of, let us say, miscellaneous related research, which industry has expended on the breeder reactor program, but the bulk of the effort will be a Government effort.

Represenative HAMILTON. Now, that Clinch River breeder reactor is to be ready in 1982. It was to be ready in 1977, and it was going to cost ERDA $669 million. In the past 6 years, its start has slipped by 5 years and the costs have now gone up to the figure just given of $1.7 billion.

The fast-flux test facility was to be finished in 6 years and has now gone to 8 and has gone up in price from $87 million to something over $500 million.

The sodium-pump test facility has gone from $6.8 million to $57.5 million and that is about an eightfold increase. It is not anywhere near completion, as I understand it.

Now, this is not a very good track record with regard to getting along on schedule or within cost estimates. If that has been the history, is there any reason at all we ought to take the present figures seriously?

Mr. CARLONE. As Mr. Staats indicated in his opening remarks, we are looking at the cost-schedule estimates for the Clinch River breeder reactor, and we would hope to have a report on that within a couple of weeks. We will be talking about the methodology that ERDA used in developing the $1.7 billion estimate and our comments on it.

Representative HAMILTON. Well, how did these kinds of grossly underestimated costs and time schedules come about? Was Congress misled on this? Were we deliberately misled? If so, by whom? How do these things occur?

Mr. HUGHES. I think the answer is pretty complicated and subject to some debate. First of all, there is the general factor of inflation. For instance, with respect to the $1.7 billion for the Clinch River reactor, my recollection is that around half a billion of that cost escalation is essentially inflation; that is, it is unrelated to design changes or other cost estimates.

With respect to the total program, it was around $3.5 billion for inflation, so you can kind of put that part aside.

Representative HAMILTON. Well, let's look at that figure for a moment now. You are giving me a 75-percent inflation figure over that period of time, which is much more than the general inflation rate. Now, surely not all of that is what you are suggesting?

Mr. CARLONE. Some of that accounts for improvements in the program and for problems that they did not anticipate, where they had to do further testing, and further modification of facilities. So not only inflation, but problems they didn't anticipate are represented in the current estimate.

Representative HAMILTON. That is what I am trying to get at. I want to have an analysis of why we have these cost overruns. What percentage of the total cost overruns reflects inflation and what is due to other factors?

Mr. HUGHES. Let's stick with the Clinch River breeder reactor for a minute. The $500 million figure, if my recollection is correct, is an inflation figure; $500 million of the increased costs from the original estimate is inflation. Is that correct?

Mr. CARLONE. That is correct. It is around $500 million to $600 million.

Representative HAMILTON. The original cost figure was $669 million?

Mr. HUGHES. $699 million. So, from $700 million to $1.2 billion in round numbers is essentially inflation, as I understand it. Roughly half the total increase in the program cost is inflation. The balance consists of the kind of factors that Mr. Carlone has referred to. They represent a learning process, in effect, as the project is carried along. They are perhaps in a sense the product of proceeding with a series of related efforts simultaneously. So that we are learning as we go along. And as we learn, we have to modify the project to improve certain aspects of it and that increases the cost.

Representative HAMILTON. Mr. Hughes, the 1969 estimate was $700 million, and you have given us roughly a $500 million figure for inflation, and additions to the program of an additional $500 million, which brings it up to $1.7 billion. That would suggest the inflation was 72 percent of the original costs.

The consumer price index is up about 45 or 50 percent since 1969. I don't understand your figure of some 72 percent inflation.

Mr. HUGHES. I don't think I want to try and defend the figure here, Mr. Hamilton, but I would point out that inflation in some sectors of the economy has been substantially higher than others.

Representative HAMILTON. Has that been true in these things?

Mr. HUGHES. I would have to assume so. I think the $500 million figure is a kind of agreed-on number. I believe ERDA could talk to this point more specifically, but I don't believe it is in dispute.

Mr. ESCHWEGE. I think in this case the inflation factor does carry forward. As we said earlier, on the total program of $10 billion there is no inflation factor provided after fiscal year 1976. However, with respect to this project, it does include the total inflation factor up through the end of a 5-year operation period in 1987.

Representative HAMILTON. How do the cost overruns we are seeing in this program compare to other cost overruns, like many of these defense projects we hear so much about?

Mr. STAATS. Well, we have done studies and we have had reports quarterly, of course, to Congress on the Defense Department. We have also begun to develop studies on the civilian projects, Congressman. I guess I would have to say this overrun is not as high as the interstate highway program.

Chairman HUMPHREY. As what?

Mr. STAATS. The interstate highway program. That turns out to be one where our estimate was worse.

Representative HAMILTON. That is the granddaddy of them all.

Mr. STAATS. That is true.

Representative HAMILTON. What is the percentage overrun of the Interstate Highway cost?

Mr. STAATS. I would have to get that for you, but it is very high. I would be glad to send you a copy of it.

Representative HAMILTON. Mr. Chairman, I think it would be helpful to put it in the record at this point.

Senator HUMPHREY. Certainly.

[The following information was subsequently supplied for the record:]

The Federal Highway Administration's Interstate Highway System was estimated in 1958 to cost $37,600,000,000 of which the Federal Government's share was $33.9 billion. The most current estimate, 1972, shows that the estimate has doubled to $76,300,000,000. The Government's share of the latest estimate is $68.26 billion.

Representative HAMILTON. Could you give us a comparison of cost overruns on the breeder reactor as compared with other items too?

Mr. STAATS. We could give you that in military areas as well as civilian areas.

[The following reports were subsequently supplied for the record:]

REPORT TO THE CONGRESS

Status Of Selected Major Weapon Systems

Department Of Defense

BY THE COMPTROLLER GENERAL OF THE UNITED STATES

PSAD-75-53

COMPTROLLER GENERAL OF THE UNITED STATES
WASHINGTON, D.C. 20548

B-163058

To the President of the Senate
and the Speaker of the House of Representatives

This is our fourth semiannual report to the Congress on the status of selected major weapon systems being acquired by the Department of Defense. All cost, schedule, and performance data in this report was extracted from the selected acquisition report released by the Department. We have not audited or verified the data.

Systems are periodically added to and deleted from the selected acquisition report on the basis of recommendations from the services or the Office of the Secretary of Defense and/or interest expressed by the Congress or GAO. This report details the net cost changes reported on 49 major weapon systems between December 31, 1973, and June 30, 1974. It also lists systems which have reported schedule slippages of 12 months or more in the planned delivery dates as of June 30, 1974, and those which, in our opinion, have experienced significant changes in planned performance.

We made our review pursuant to the Budget and Accounting Act, 1921 (31 U.S.C. 53), and the Accounting and Auditing Act of 1950 (31 U.S.C. 67).

We are sending copies of this report to the Director, Office of Management and Budget; the Secretary of Defense; and the Secretaries of the Army, Navy, and Air Force.

Elmer B. Staats
Comptroller General
of the United States

C o n t e n t s

ABBREVIATIONS

DOD	Department of Defense
SAR	selected acquisition report

64-603 O - 76 - 7

STATUS OF SELECTED MAJOR WEAPON SYSTEMS

In 1969 the Congress asked us to report periodically on the progress and status of various system acquisitions. We issued reports annually from 1970 through 1972. Since then we have issued reports semiannually. This report includes information reported by the Department of Defense (DOD) on changes to the estimated costs of 49 major weapon systems on the selected acquisition report (SAR) during the 6 months ended June 30, 1974. There was a net increase of $17,107.8 million in estimated costs for these systems.

In addition, the report includes information on 22 systems, that were 12 months or more behind the planned schedule for delivery of the first increment and performance data on 13 systems which, in our opinion, significant improvements and/or reductions in planned performance have occurred. We have not audited or verified the cost, schedule, and performance information in the SAR.

Appendix I provides details on the cost changes that occurred between December 31, 1973, and June 30, 1974. Appendix II shows the cost data appearing on the June 30, 1974, SAR. Appendix III shows the planning and development estimates for program quantities and unit costs and changes for the 6 months ended June 30, 1974. Appendix IV lists systems which have reported schedule slippages of 12 months or more in the planned delivery dates and systems which, in our opinion, significant improvements or reductions in planned performance had occurred as of June 30, 1974.

CURRENT ESTIMATE CHANGES FROM
DECEMBER 31, 1973, TO JUNE 30, 1974

An analysis of cost changes on 49 weapon systems on SAR during the 6 months ended June 30, 1974, showed a net increase in total cost of about $17.1 billion.

Of the total cost increase, $16.5 billion was attributed to higher inflation indexes in preparing the estimates. DOD policy states that the best estimate of the acquisition cost of weapon systems, including a realistic provision for experienced and projected inflation, is to be shown in the SAR. The provision for inflation in weapon system cost estimates is to be based on Service-developed indexes representing the condition pertinent to a particular program. However, in the absence of such individual program indexes, the escalation indexes published by the Office of the Assistant Secretary of Defense (Comptroller), for more general application may be used.

For the December 1973 and March 1974 SARs, the Office of the Assistant Secretary (Comptroller) published escalation indexes which provided for a 4.5 percent increase for procurement costs for fiscal year 1975 and 3.1 percent for fiscal year 1976 and each year thereafter. These rates changed for the June 1974 SARs when the Office of the Assistant Secretary (Comptroller) published revised indexes which provided the following escalation indexes for application to procurement costs.

Fiscal year	Index	Percentage
1974	100.0	Base year
1975	111.0	11.0
1976	119.9	8.0
1977	128.3	7.0
1978	134.7	5.0
1979	140.6	4.4
1980	146.7	4.3
All subsequent years		3.7

Similar escalation indexes were developed for application to research and development costs.

Cost change analyses for the 6 months ended June 30, 1974, are shown in the following table.

Type of change	Army	Navy	Air Force	Change during period
	(millions)			
Total quantity increase--net	$ 18.3	$ 2.7	$ -	$ 21.0
Other changes:				
Engineering	66.9	110.1	31.5	208.5
Support	-40.8	-7.1	2.5	-45.4
Schedule	297.3	-32.0	31.4	296.7
Economic	3,675.2	7,028.3	5,786.2	16,489.7
Estimating	-41.2	49.2	-4.5	3.5
Sundry	-111.4	255.6	-10.4	133.8
Total-other changes	3,846.0	7,404.1	5,836.7	17,086.8
Total	$3,864.3	$7,406.8	$5,836.7	$17,107.8
Number of systems (total 49)	14	24	11	49

COST DATA COMPARISON FROM
DECEMBER 31, 1973, TO JUNE 30, 1974

Number of systems (note a)	Planning estimate	Development estimate	Cost change (note b) Quantity decrease(-)	Other	Current estimate
			(millions)		
Army (14)	$19,170.8	$ 20,225.2	$-1,266.8	$ 4,371.4	$ 23,329.8
Navy (24) (note c)	44,437.6	52,569.4	- 161.5	7,728.2	60,136.1
Air Force (11)	29,028.4	36,687.0	-2,634.1	13,303.9	47,356.8
Total at 12-31-73 (49)	$92,636.8	$109,481.6	$-4,062.4	$25,403.5	$130,822.7
Army (14)	$19,170.8	$ 20,225.2	$-1,691.8	$ 8,660.7	$ 27,194.1
Navy (24) (note c)	44,437.6	52,569.4	- 118.5	15,092.0	67,542.9
Air Force (11)	29,028.4	36,703.5	-2,648.1	19,138.1	53,193.5
Total at 6-30-74 (49)	$92,636.8	$109,498.1	$-4,458.4	$42,890.8	$147,930.5
Difference for 49 systems	-	$ 16.5	$- 396.0	$17,487.3	$ 17,107.8

[a]The total number of systems on SAR at December 31, 1973, was 53 and the total number of systems on SAR at June 30, 1974, was 49. Three Navy systems--EA-6B, HARRIER and BQQ-5--were deleted from SAR as of December 31, 1973. One Army system--M60A2--was deleted from SAR as of March 31, 1974. The M60A2 SAR reported no cost change between December 1973 and March 1974.

[b]These cost changes represent total change for each system from the time a development estimate is established--generally the time a development contract is awarded for a system--through the current estimate, or the date of SAR--in this case June 30, 1974.

[c]The estimates for the Navy systems include costs of the Air Force portion of the SPARROW F and SIDEWINDER AIM-9L missile programs. For example, the Navy's current estimate at December 31, 1973, includes Air Force costs of $514.7 million for the SPARROW F and $197.4 million for the SIDEWINDER. The current estimate at June 30, 1974, includes Air Force costs of $510.4 million for the SPARROW F and $241.2 million for the SIDEWINDER.

APPENDIX I

Following is a summary by military service of cost changes during the 6 months ended June 30, 1974, for 49 major weapon systems as reported on the SAR.

ARMY NET INCREASE OF $3,864.3 MILLION:

IMPROVED HAWK MISSILE:

Increase of $21.9 million:

Net result of (1) $0.6 million increase for Government support for modifications validation test program, (2) $0.2 million decrease for prior years adjustment to ground support equipment, and (3) $21.5 million increase due to applying higher inflation provisions.

LANCE MISSILE:

Increase of $20.7 million:

Result of (1) $16.2 million due to applying higher inflation provisions, (2) $0.7 million for procuring safe and arm cover lock for safety purposes, and (3) $3.8 million for test and handling equipment, and adjusting repair parts of prior year funds to actual receipts.

TOW MISSILE:

Increase of $26.4 million:

Net result of (1) $42.8 million increase due to applying higher inflation provisions, and (2) $16.4 million decrease due to revising and refining estimates.

DRAGON MISSILE:

Increase of $38.5 million:

Net result of (1) $70.9 million increase due to applying higher inflation provisions, (2) $0.9 million increase for beginning development of night sight, and (3) $33.3 million decrease due to contract negotiation, new contract proposals and refining estimates.

APPENDIX I

SAFEGUARD BALLISTIC MISSILE DEFENSE SYSTEM:

Decrease of $41 million:

Net result of (1) $67 million quantity increase, (2) $6 million increase due to revising and refining estimates, and (3) $114 million decrease attributed to revising the previously estimated cost for lost effort; i.e., costs incurred for effort required for the larger deployment planned before the ABM Treaty and subsequent congressional action but which is not useful to the current one site deployment.

SAM-D SURFACE TO AIR MISSILE SYSTEM:

Increase of $1,489.3 million:

Net result of (1) $1,229.9 million increase due to applying higher inflation provisions, (2) $47 million quantity decrease, (3) $58.7 million net increase for study of a cost reduction program and SAM-D II changes and deleting non-nuclear warhead and nuclear interface, (4) $293.6 million increase for schedule stretchout, (5) $1.3 million decrease for refining estimates, and (6) $44.6 million decrease for costs associated with common equipment.

TACFIRE (TACTICAL FIRE DIRECTION SYSTEM):

Increase of $11.3 million:

Net result of (1) $11 million increase due to applying higher inflation provisions, (2) $2 million increase in engineering changes and added depot maintenance effort, and (3) $1.7 million quantity decrease.

UTTAS HELICOPTER:

Increase of $727.2 million:

Result of revised provision for inflation.

HLH HELICOPTER:

Increase of $2.3 million:

Result of revised provision for inflation.

MICV VEHICLE:

Increase of $63.3 million:

Net result of (1) $61 million increase for applying higher inflation provisions, (2) $3 million increase in contract cost overrun, (3) $0.3 million decrease for reducing in-house cost, and (4) $0.4 million decrease identified with contract performance incentives.

STINGER MISSILE:

Increase of $112.4 million:

Result of (1) $100.4 million due to applying higher inflation provisions, (2) $7.7 million for adding a Design-to-Cost program, and (3) $4.3 million for test target costs.

AAH HELICOPTER:

Increase of $517.1 million:

Result of revised provision for inflation.

XM-1 TANK:

Increase of $874.9 million:

Result of revised provision for inflation.

NAVY NET INCREASE OF $7,406.8 MILLION:

MARK-48 TORPEDO:

Increase of $96.9 million:

Net result of (1) $100.9 million increase due to applying higher inflation provisions, (2) $0.2 million increase in support costs, and (3) $4.2 million decrease due to refining estimates.

APPENDIX I

F-14A AIRCRAFT:

Decrease of $45.9 million:

Net result of (1) $50.1 million increase due to applying higher inflation provisions, (2) $3.6 million decrease in support costs, and (3) $92.4 million decrease primarily due to cost savings to Navy resulting from Iran's buying aircraft, adjusting estimates to actual costs, and reducing procurement funds for fiscal year 1972 and prior years.

SSN-688 SUBMARINE:

Increase of $840.6 million:

Result of (1) $840.4 million due to applying higher inflation provisions and (2) $0.2 million for military construction costs.

DLGN-38 CLASS SHIP:

Increase of $225 million:

Result of (1) $200 million due to applying higher inflation provisions, (2) $9.2 million increase based on improved estimating experience, and (3) $15.8 million due to revised shipbuilder cost.

SPARROW F MISSILE:

Decrease of $19.8 million: (Navy $15.5 million, Air Force $4.3 million)

Net result of (1) $111.2 million increase due to applying higher inflation provisions, (2) $131.2 million decrease attributed to program repricing based on fiscal year 73 and fiscal year 74 negotiated contracts, stabilizing missile configuration, and reevaluating manufacturing support, (3) $0.1 million unpredictable decrease, and (4) $0.3 million increase attributed to contract performance incentives.

POSEIDON MISSILE:

Increase of $9.1 million:

Net result of (1) $12.8 million increase for modification program and (2) $3.7 million net decrease for revising and refining estimates.

CONDOR MISSILE:

Increase of $16.5 million:

Result of (1) $5 million due to applying higher inflation provisions, (2) $8.2 million due to a break in production, and (3) $3.3 million engineering change for active radar seeker.

CVAN-68 CLASS AIRCRAFT CARRIER:

Increase of $211.9 million:

Result of applying higher inflation provisions.

A-7E AIRCRAFT:

Increase of $22.9 million:

Net result of (1) $17.7 million increase due to applying higher inflation provisions, (2) $5.6 million increase for TRAM development and reliability testing, (3) $0.4 million increase for refining estimates, and (4) $0.8 million decrease for adjusting prior contracts.

PHOENIX MISSILE:

Increase of $35.2 million:

Net result of (1) $37.9 million increase due to applying higher inflation provisions and (2) $2.7 million decrease for refining estimates.

S-3A AIRCRAFT:

Increase of $48 million:

Result of (1) $36 million due to applying higher inflation provisions and (2) $12 million due to S-3A line shutdown costs.

APPENDIX I

E-2C AIRCRAFT:

Increase of $1.7 million:

Net result of (1) $6 million increase due to applying higher inflation provisions and (2) $4.3 million decrease for refining estimates.

LHA SHIP:

Increase of $34.6 million:

Result of (1) $14.9 million due to applying higher inflation provisions, (2) $0.5 million for support costs, (3) $9.2 million attributed to post delivery, project support and Government furnished equipment, and (4) $10 million attributed to contract changes.

VAST (VERSATILE AVIONICS SHOP TEST SYSTEM):

Increase of $0.9 million:

Result of applying higher inflation provisions.

P-3C AIRCRAFT:

Decrease of $24.8 million:

Net result of (1) $24.7 million increase due to applying higher inflation provisions, (2) $0.1 million increase for adjusting prior year costs, and (3) $49.6 million quantity reduction.

DD-963 SHIP:

Increase of $521.1 million:

Result of (1) $277.7 million due to applying higher inflation provisions, (2) $1.7 million in outfitting costs, (3) $23.3 million for contract performance incentives, and (4) $218.4 million for contract cost overrun.

HARPOON MISSILE:

Increase of $147.1 million:

Result of applying higher inflation provisions.

PHM SHIP:

Increase of $351 million:

Result of (1) $249.3 million due to applying higher inflation provisions, (2) $85.3 million attributed to labor learning curve change, increased man-hours and material, and refining estimates, and (3) $16.4 million for contract cost overrun.

TRIDENT UNDERSEA STRATEGIC MISSILE SYSTEM:

Increase of $3,015.3 million:

Result of (1) $2,892.5 million due to applying higher inflation provisions and (2) $122.8 million for refining estimates.

PF SHIP:

Increase of $1,791.8 million:

Result of (1) $1,661.6 million due to applying higher inflation provisions, (2) $76.9 million attributed to design changes, (3) $11.8 million support change, and (4) $41.5 million for revised estimates.

SIDEWINDER AIM-9L MISSILE:

Increase of $68.7 million: (Navy $24.9 million, Air Force $43.8 million)

Net result of (1) $56.5 million increase due to applying higher inflation provisions, (2) $2.5 million increase for redesigning guidance control section, (3) $0.1 million increase for support costs, (4) $13.5 million increase for stretchout of development program and revised production schedule, (5) $0.3 million increase due to work stoppage at contractor plant, and (6) $4.2 million decrease due to revised procurement support costs.

PHALANX ANTI-SHIP-MISSILE DEFENSE SYSTEM:

Increase of $62.8 million:

Net result of (1) $63.8 million increase due to applying higher inflation provisions and (2) $1 million decrease for refining estimates.

APPENDIX I

CH-53E HELICOPTER:

Decrease of $3.8 million:

Net result of (1) $22.2 million increase due to applying higher inflation provisions, (2) $7.5 million increase for support changes, and (3) $33.5 million decrease due to repricing airframe and changes, engines and accessories, electronics, and Government-furnished equipment.

AIR FORCE NET INCREASE OF $5,836.7 MILLION:

AWACS (AIRBORNE WARNING AND CONTROL SYSTEM):

Increase of $178.8 million:

Result of applying higher inflation provisions.

F-5E AIRCRAFT:

Decrease of $0.2 million:

Result of renegotiating engine contract.

MAVERICK MISSILE:

Increase of $0.6 million:

Net result of (1) $15.4 million increase due to applying higher inflation provisions, (2) $10.4 million decrease in contractor overtarget estimate, and (3) $4.4 million decrease for refining engineering change estimate.

F-111 AIRCRAFT:

Decrease of $8.1 million:

Result of the deletion of the second "F" Simulator.

SRAM MISSILE:

Decrease of $0.6 million:

Revised estimate of military construction costs based on actual expenditures in prior years.

B-1 AIRCRAFT:

Increase of $3,632.6 million:

Result of applying higher inflation provisions.

F-15 AIRCRAFT:

Increase of $1,667.1 million:

Result of (1) $1,620 million due to applying higher inflation provisions, (2) $31.5 million for closeout of system test and development, and (3) $15.6 million due to a revised spares program and adjustments of other support items.

A-10 AIRCRAFT:

Increase of $212.6 million:

Result of applying higher inflation provisions.

MINUTEMAN III MISSILE:

Increase of $114.8 million:

Net result of (1) $115.8 million increase due to applying higher inflation provisions and (2) $1 million decrease for refining estimates.

A-7D AIRCRAFT:

Decrease of $3.3 million:

Net result of (1) $5 million decrease attributed to deleting 5th simulator and (2) $1.7 million increase primarily for the airframe structural integrity program and an increase in requirements for aerospace ground equipment.

AABNCP (ADVANCED AIRBORNE COMMAND POST):

Increase of $42.4 million:

Result of (1) $11 million due to applying higher inflation provisions and (2) $31.4 million attributed to additional system engineering/technical direction effort, contractor holding cost, and delay in procuring production systems in conformance with congressional direction.

APPENDIX II

PROGRAM COST DATA APPEARING ON JUNE 30, 1974, SAR

System	Planning estimate	Development estimate	Cost change: Quantity decrease(-)	Cost change: Other	Current estimate
	(millions)				
Army (14):					
IMPROVED HAWK	$ 335.5	$ 588.2	$- 105.1	$ 369.3	$ 852.4
LANCE	586.7	652.9	145.8	147.0	945.7
TOW	410.4	727.3	- 107.5	359.5	979.3
DRAGON	382.2	404.2	4.9	271.3	680.4
SAFEGUARD (notes a and b)	4,185.0	4,185.0	-1,198.0	2,375.0	5,362.0
SAM-D	4,916.8	5,240.5	- 480.7	1,629.2	6,389.0
SCOUT (note b)	244.6	244.6	-	17.7	262.3
TACFIRE	123.6	160.5	32.3	98.5	291.3
UTTAS (note b)	2,307.3	2,307.3	- 22.0	1,117.5	3,402.8
HLH (note b)	189.9	189.9	38.5	25.9	254.3
MICV	209.4	245.4	-	99.5	344.9
STINGER (note b)	473.8	473.8	-	162.5	636.3
AAH (note b)	1,800.2	1,800.2	-	718.0	2,518.2
XM1 TANK (note b)	3,005.4	3,005.4	-	1,269.8	4,275.2
Total	$19,170.8	$20,225.2	$-1,691.8	$ 8,660.7	$27,194.1
System deleted as of March 31, 1974 (1):					
M60A2	$ 162.1	$ 205.6	$- 45.3	$ 246.5	$ 406.8

PROGRAM COST DATA APPEARING ON JUNE 30, 1974, SAR

System	Planning estimate	Development estimate	Cost change: Quantity decrease(-)	Cost change: Other	Current estimate
	(millions)				
Navy (24):					
MARK-48	720.5	1,753.8	- 470.0	273.4	1,557.2
F-14A (notes b & c)	6,166.0	6,166.0	-1,005.7	1,146.7	6,307.0
SSN-688	1,658.0	5,747.5	777.0	1,338.1	7,862.6
AEGIS	388.0	427.6	-	121.7	549.3
DLGN-38 (note d)	769.2	820.4	515.3	256.1	1,591.8
SPARROW F (note e)	151.5	707.7	- 164.0	766.5	1,310.2
POSEIDON (note b)	4,568.7	4,568.7	- 206.1	428.1	4,790.7
CONDOR	356.3	441.0	- 216.5	188.0	412.5
CVAN-68 CLASS	1,919.5	2,036.2	-	521.6	2,557.8
A-7E (note b)	1,465.6	1,465.6	314.8	810.1	2,590.5
PHOENIX	370.8	536.4	44.3	573.6	1,154.3
S-3A	1,763.8	2,891.1	- 118.2	515.8	3,288.7
E-2C (note b)	586.2	586.2	100.3	298.3	984.8
LHA (note b)	1,380.3	1,380.3	- 436.9	236.5	1,179.9
VAST	241.1	312.0	- 158.5	295.4	448.9
P-3C (note b)	1,294.2	1,294.2	973.6	456.2	2,724.0
DD-963	1,784.4	2,581.2	-	1,017.4	3,598.6
HARPOON (note b)	1,071.4	1,071.4	- 93.9	201.4	1,178.9
PHM (note b)	726.2	726.2	-	381.3	1,107.5
TRIDENT (note b)	12,431.1	12,431.1	-	3,015.3	15,446.4
PF (note b)	3,244.5	3,244.5	-	2,030.1	5,274.6
SIDEWINDER AIM-9L (notes b and e)	233.4	233.4	26.0	114.2	373.6
PHALANX (note b)	568.5	568.5	-	134.5	703.0
CH-53E (note b)	578.4	578.4	-	- 28.3	550.1
Total	$44,437.6	$52,569.4	$- 118.5	$15,092.0	$67,542.9
Systems deleted as of December 31, 1973 (3):					
EA-6B	$ 689.7	$ 817.7	$ 296.0	$ 537.4	$ 1,651.1
HARRIER	503.6	503.6	2.5	- 5.7	500.4
BQQ-5	610.4	610.4	69.5	132.1	812.0

APPENDIX II

PROGRAM COST DATA APPEARING ON JUNE 30, 1974, SAR

System	Planning estimate	Development estimate	Cost change: Quantity decrease(-)	Cost change: Other	Current estimate
			(millions		
Air Force (11):					
AWACS	$2,656.7	$2,661.6	$- 172.3	$ 166.1	$2,655.4
F-5E	698.6	315.5	102.3	4.7	422.5
MAVERICK	257.9	383.4	57.3	132.5	573.2
F-111	4,686.6	5,505.5	- 2,598.0	4,210.3	7,117.8
SRAM	167.1	236.6	96.8	821.8	1,155.2
B-1	8,954.5	11,218.8	- 27.9	7,441.7	18,632.6
F-15	6,039.1	7,355.2	-	3,586.1	10,941.3
A-10 (note f)	1,025.5	2,489.7	-	243.8	2,733.5
MINUTEMAN III	2,695.5	4,673.8	62.4	2,224.9	6,961.1
A-7D (note b)	1,379.1	1,379.1	- 168.7	271.9	1,482.3
AABNCP (note g)	467.8	484.3	-	34.3	518.6
Total	$29,028.4	$36,703.5	$- 2,648.1	$19,138.1	$53,193.5

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[a]The original planning estimate of $4,185 million was for two sites. The current estimate of $5,362 million covers one site in accordance with the Treaty on Limitation of Anti-Ballistic Missile Systems ratified by the Senate on Oct. 3, 1972.

[b]For those programs with only a development or a planning estimate available, we have made both estimates the same to prevent distortion between the totals of the column.

[c]The requirement for the Dec. 31, 1972, and Mar. 31, 1973, SAR was waived pending the restructuring of the program. Beginning June 30, 1973, the F-14 SAR became the F-14A SAR because present Navy plans do not call for procuring the F-14B version of the aircraft. The development estimate on the June 30, 1973, SAR was revised and decreased $243 million to delete estimated costs related to the F-14B aircraft. On the Sept. 30, 1973, SAR, the $243 million was reinserted at the request of the Congress.

[d]Before issuing the present contract, the Navy's long-range program included 23 ships of this class for a planning estimate of $3,980 million in fiscal year 1970 dollars. The present program is for five ships.

[e]Estimates include Air Force costs for research, development, and procurement.

[f]The A-10 was formerly known as the A-X aircraft. The planning estimate of $1,025.5 million represents the total program cost estimate as cited in the development concept paper. This planning estimate is stated in constant 1970 dollars, based on a 600-aircraft program, and considers a turboprop configuration.

[g]The Mar. 31, 1974, SAR for the AABNCP included a development estimate for the first time.

QUANTITY AND UNIT COST CHANGES

Cost growth in major weapon systems results from such things as unanticipated development difficulties, faulty planning, poor management, poor estimating, or underestimating. However, not all cost growth can reasonably be prevented. For instance, unusual periods of inflation may result in cost growth. Changes in technology may make it possible to incorporate modifications that result in an overall increase in the system's effectiveness. Such cost growth cannot always be anticipated, particularly when a weapon system is in development and production over long periods.

Cost growth has been a significant reason for reducing the number of units of a weapon system to be acquired by the services. Continued cost growth and the need to stay within budgetary limitations will undoubtedly result in significant reductions in the number of units to be acquired for many of the new systems under development.

The schedules on the following pages show the planning and development estimates for quantities and unit costs originally planned for the weapon system programs. The schedules also show the current estimate for quantities and unit costs at June 30, 1974, and the quantity changes and unit cost changes during the 6 months ended June 30, 1974.

QUANTITY CHANGES AND UNIT COST CHANGES

DURING THE 6 MONTHS ENDED JUNE 30, 1974

System	Planning and development estimates		Current estimate June 30, 1974	
	Quantity	Unit cost (millions)	Quantity	Unit cost (millions)
Army (14):				
IMPROVED HAWK	(a)	$ (b) 5.71	(a)	$ 9.27
LANCE	(a)	(a)	(a)	(a)
TOW	233,081	.00312	129,455	.007564
DRAGON	247,360	.001634	87,200	.007803
SAFEGUARD	2	(c)2,092.5	1	(c)5,362.0
SAM-D	(a)	(a)	(a)	(a)
SCOUT	1,155	.212	1,155	.227
TACFIRE	149	(d)1.077	(a)	(a)
UTTAS	1,123	2.05	1,117	3.05
HLH (PROTOTYPE)	(e)	(e)	(e)	(e)
MICV	1,205	.204	1,205	.286
STINGER	(a)	(a)	(a)	(a)
AAH	481	3.7	481	5.24
XM1 TANK	3,323	.904	3,323	1.287
Navy (24):				
MARK-48	4,194	.418	(a)	(a)
F-14A	469	12.629	334	17.774
SSN-688	32	179.609	36	218.406
AEGIS	(f)	(f)	(f)	(f)
DLGN-38	3	254.9	5	318.36
SPARROW F	(j)15,685	.045	(j)12,204	.107
POSEIDON	31	(g)147.377	31	(g)154.539
CONDOR	3,348	.132	538	.767
CVAN-68 CLASS	3	(h)678.7	3	(h)852.6
A-7E	595	2.463	646	4.010
PHOENIX	2,384	.225	2,532	.456
S-3A	199	14.5	187	17.587
E-2C	30	19.5	36	27.356
LHA	9	153.366	5	235.98
VAST	207	1.507	89	5.044
P-3C	104	12.444	214	12.729
DD-963	30	86.040	30	119.953
HARPOON	4,262	.251	2,922	.403
PHM	30	24.2	30	36.917
TRIDENT	10	(i)1,243.11	10	(i)1,544.64
PF	50	64.890	50	105.492
SIDEWINDER (AIM-9L)	(j)9,288	.025	(j)10,333	.036
PHALANX	370	1.536	367	1.916
CH-53E	74	7.8	74	7.4
Air Force (11):				
AWACS	42	63.4	34	78.1
F-5E	87	3.63	154	2.74
MAVERICK	17,205	.022	22,186	.026
F-111	1,388	3.97	478	14.89
SRAM	700	.338	1,500	.770
B-1	246	45.6	244	76.4
F-15	749	9.82	749	14.61
A-10	743	3.35	743	3.68
MINUTEMAN III	760	6.15	750	9.28
A-7D	517	2.67	435	3.41
AABNCP	7	69.2	7	74.1

Change during period	
Quantity change decrease (-)	Unit cost change decrease (-) (millions)
0	$ .24
(a)	(a)
0	.000203
0	.000442
0	-41.0
(a)	(a)
0	0
(a)	(a)
0	.65
(e)	(e)
0	.052
(a)	(a)
0	1.04
0	.264
(a)	(a)
0	- .137
0	23.35
(f)	(f)
0	44.96
0	- .002
0	.294
0	.031
0	70.63
0	.035
0	.014
0	.287
0	.056
0	6.92
0	.01
- 6	.235
0	17.37
0	.05
0	11.717
0	301.53
0	35.836
0	.007
0	.172
0	- .1
0	5.3
0	- .01
0	0.0
0	- .02
0	- .001
0	14.9
0	2.228
0	.29
0	.15
0	- .01
0	6.07

[a] Classified.

[b] Per battery.

[c] Per site.

[d] Per set.

[e] None listed.

[f] No procurement costs or quantities provided.

[g] Per system (missile unit cost and quantities are classified.

[h] Estimated program cost divided by three ships.

[i] Estimated program cost divided by 10 hulls.

[j] Includes Air Force quantities.

PERFORMANCE AND SCHEDULE CHANGES

The justification for selecting a particular major weapon system to fulfill a need includes analyzing many existing and alternative capabilities and establishing a priority of need. It is important that clear performance goals for a system be defined early in the development process.

Overly ambitious performance requirements, combined with low initial cost predictions and optimistic risk estimates, lead almost inevitably to schedule slippages, performance degradations, and cost increases. Attempts to keep total program costs from rising lead to reductions in planned quantities which, in turn, increase unit cost. The following schedule lists weapon systems which have reported schedule slippages of 12 months or more in the planned delivery dates and systems in which, in our opinion, significant improvements and/or reductions in planned performance characteristics were anticipated as of June 30, 1974.

Because specific data on the performance of a weapon system and its date for delivery or initial operational capability are generally classified, this unclassified report does not provide that detail. In individual weapon system staff studies issued to the Congress early each calendar year, we have reported details of performance and schedule changes. Also, the Department of Defense tracks performance and schedule changes and reports them quarterly on SARs.

MAJOR WEAPON SYSTEMS WITH SCHEDULE SLIPPAGES OF
12 MONTHS OR MORE AND PERFORMANCE CHARACTERISTIC
CHANGES AS OF JUNE 30, 1974

System	Schedule slippage: Previously reported	Schedule slippage: Additional slippage reported during 6 months	Performance characteristic changes: Previously reported: Improvement	Performance characteristic changes: Previously reported: Reduction	Performance characteristic changes: During 6 months: Improvement	Performance characteristic changes: During 6 months: Reduction
Army:						
MICV						d X
IMPROVED HAWK	X			X		
LANCE (note a)	X		X	X		
TOW	X					
DRAGON (note a)	X		X	X		
SAM-D	X			X		c X
SCOUT				X		
TACFIRE	X					
Navy:						
SSN-688	X	4 months				
AEGIS	X					
DLGN-38	X	2 to 5 months				
SPARROW F	X					
CONDOR	X					
PHALANX		bX		X		
CVAN-68 CLASS	X	3 to 9 months				
P-3C				X		
LHA	X					
VAST	X					
SIDEWINDER AIM-9L	X			X		
DD-963				X		
PF				X		
Air Force:						
AWACS	X					
MAVERICK	X					
SRAM	X		X			
B-1	x			X		
A-7D	X					
AABNCP		bX				

[a]On these systems some aspects of performance have improved and some have been reduced. We did not attempt to assess the overall effect on performance capability.

[b]As of June 30, 1974, the PHALANX and AABNCP systems, for the first time, have reported cumulative schedule slippages exceeding 12 months.

[c]Changes in SAM-D performance characteristics are due to an effort to develop a lower cost system--the SAM-D II.

[d]Change in MICV performance characteristics is due to cost tradeoffs and design changes required for the vehicle to meet reliability and durability requirements.

REPORT TO THE CONGRESS

Financial Status Of Major Civil Acquisitions December 31, 1973

BY THE COMPTROLLER GENERAL
OF THE UNITED STATES

PSAD-75-58

COMPTROLLER GENERAL OF THE UNITED STATES
WASHINGTON, D.C. 20548

B-182956

To the President of the Senate and the
Speaker of the House of Representatives

This is our first annual summary report to the Congress on the financial status of selected major civil acquisitions funded by the Federal Government. The report also covers some acquisitions financed jointly with Federal, State, and other funds.

Departments and agencies responsible for the major civil acquisitions furnished the financial data on 269 projects in this report. We have not audited or verified the accuracy or completeness of this data and because of the large number of projects involved, we obtained explanations for cost growth only for those having increases of 100 percent or more. Inflation, engineering, estimating and quantity changes were identified as the major causes of cost growth. These agencies generally do not publish periodic reports similar to the quarterly Selected Acquisition Reports on major systems that the Department of Defense furnishes to congressional committees and others. As a result, the agencies had to make a special effort over several months to obtain the data we requested as of December 31, 1973.

We made our review pursuant to the Budget and Accounting Act, 1921 (31 U.S.C. 53), and the Accounting and Auditing Act of 1950 (31 U.S.C. 67).

We are sending copies of this report to the Director, Office of Management and Budget; and to the Secretaries of the various departments and the heads of independent agencies involved.

Elmer B. Staats

Comptroller General
of the United States

Contents

ABBREVIATIONS

GAO General Accounting Office

RDT&E research, development, test, and evaluation

FINANCIAL STATUS OF MAJOR CIVIL ACQUISITIONS

DECEMBER 31, 1973

In 1969, because of congressional interest, GAO began to periodically report on major weapon acquisitions so that congressional committees and members would have available, reliable data on which to base judgments concerning these programs. In response to numerous inquiries for similar data on civil programs, we have prepared this consolidated financial status report on selected major non-defense acquisitions. It is our first annual report and covers 269 major acquisitions estimated to cost $133 billion upon completion--an increase of $57 billion over initial (or baseline when initial estimates were not available or outdated) cost estimates. (See app. I.) Future financial status reports will contain data as of June 30 of each year and will be available to the Congress in the fall.

We have also furnished to congressional committees five staff studies on individual civil major acquisitions during the past 2 fiscal years and will furnish eight additional reports this year. (See app. IV.) The detailed reports will discuss cost, schedule, and performance characteristics, as well as management problems for specific programs.

Departments and agencies responsible for the major civil acquisitions generally do not publish periodic reports similar to the quarterly Selected Acquisition Reports on major systems that the Department of Defense furnishes to congressional committees and others. As a result, they had to make a special effort, over several months, to obtain the data requested as of December 31, 1973. The agencies identified their major acquisitions for us as those:

1. Funded and authorized or appropriated by congressional committee action.

2. Involving $25 million or more in Federal funds.

3. Funded directly by the Federal Government or by Government corporations, or involving at least 50 percent Federal funding.

4. Specifying scope of work, estimated total cost, measurable time to completion, and performance or purpose.

The agencies and departments were also asked to provide cost-growth breakdowns for acquisitions having 100 percent or more cost growth. The breakdown categories are:

1. Quantity changes--interchangeable with scope changes.

2. Engineering changes--an alteration in the established physical or functional characteristics of a system.

3. Support changes--involving spare parts, ancillary equipment, warranty provisions, and Government-furnished property and/or equipment.

4. Schedule changes--adjustments in the delivery schedule, completion date, or some intermediate milestone of development, production, or construction.

5. Economic changes--influence of one or more factors in the economy, such as inflation.

6. Estimating changes--due to corrections or other changes since the initial or other baseline estimates for program or project costs.

7. Sundry--changes which do not fall within the above categories, such as environmental costs and relocation assistance associated with water and highway projects.

An analysis of 59 acquisitions having 100 percent or more cost growth is shown in the table below. The principal factor in cost growth is engineering changes, accounting for 41 percent of the total.

Type of change	Atomic Energy Commission	Army Corps of Engineers	Department of Transportation	Other	Total change
			(millions)		
Quantity	$148.2	$1,078.8	$ 5,924.6	$ 520.8	$ 7,672.4
Engineering	118.4	1,161.4	17,463.5	375.5	19,118.8
Support	39.5	-	-	-	39.5
Schedule	23.7	388.1	-6.0	-	405.8
Economic	25.2	1,258.6	8.8	731.5	2,024.1
Estimating	223.5	985.6	9,277.9	-	10,487.0
Sundry	31.8	78.4	6,489.1	115.0	6,714.3
Total	$610.3	$4,950.9	$39,157.9	$1,742.8	$46,461.9
Number having 100 percent or more increase	2	47	4	6	59
Total projects (see app. I)	12	156	13	88	269

The $2 billion attributed to economic change principally represents inflation increases which, unlike the Department of Defense, most agencies do not include in their cost estimates. This is in line with the Office of Management and Budget's long-established policy which generally precludes allowances for future price increases in budget requests presented to the Congress. We believe that inflation is responsible for a much higher cost-growth increase than the agencies have attributed to this factor. In our future work we plan to place greater emphasis on obtaining a better analysis of the factors responsible for and amounts involved in cost growth.

We measured cost growth on each program by comparing a baseline cost with the current estimated cost, as shown in appendixes II and III. For most Federal agencies the baseline cost is the initial congressional authorization. When the departments and agencies could provide baseline figures based on more realistic definitions of scope than the initial amounts authorized, the authorization figures are provided but the baseline costs are used for comparison purposes. To obtain a more meaningful cost-growth comparison for recent years, a 1960 estimate is used for Army Corps of Engineers projects established before this date.

Acquisitions included in this report, unless otherwise indicated, are past the planning stage and into production, undergoing construction or testing. Completed projects are not included. The current estimated cost in most cases is that in effect at the end of calendar year 1973; but as noted in appendixes II and III, a number of agencies reported cost estimates developed during the first half of calendar year 1974 or later.

Scope of review

Information on major acquisitions was primarily obtained by request from 14 departments and independent agencies. In a few instances, information was obtained from prior GAO reports, other GAO records, and by reviewing congressional hearings. We have not verified the accuracy or completeness of the data furnished.

We made our review at various agency headquarter offices in Washington, D.C.

FINANCIAL STATUS OF MAJOR CIVIL ACQUISITIONS
SUMMARY BY AGENCY

Agency	Reference page of app. II	Number of projects	Original estimate	Baseline estimate	Current estimate	Increase over baseline estimate
			(000 omitted)			
Appalachian Regional Commission	7	1	$840,000	$840,000	$2,090,000	$1,250,000
Architect of the Capitol	7	2	158,800	158,800	175,122	16,322
Atomic Energy Commission	7,8	12	1,764,400	1,764,400	2,526,678	762,278
Department of the Army:						
Corps of Engineers	9 to 21	156	9,725,492	11,784,918	19,355,331	7,570,413
Department of the Interior:						
Bonneville Power Administration	21	3	127,100	127,100	152,330	25,230
Bureau of Reclamation	22 to 24	24	5,599,828	5,599,828	8,198,444	2,598,616
Department of Transportation:						
Federal Aviation Administration	24	5	412,500	412,500	850,632	438,132
Federal Highway Administration	25	2	37,750,000	37,750,000	76,450,000	38,700,000
Urban Mass Transportation Administration	25	4	85,009	85,009	143,529	58,520
U.S. Coast Guard	25	2	125,000	125,000	125,000	-

APPENDIX I

FINANCIAL STATUS OF MAJOR CIVIL ACQUISITIONS
SUMMARY BY AGENCY

Agency	Reference page of app. II	Number of projects	Original estimate	Baseline estimate	Current estimate	Increase over baseline estimate
			(000 omitted)			
Department of the Treasury	26	1	$ 50,000	$ 50,000	$ 55,300	$ 5,300
District of Columbia Government	26	7	443,200	443,200	443,200	-
General Services Administration	26,27	6	211,520	211,520	398,166	186,646
National Aeronautics and Space Administration	27,28	23	7,734,000	8,267,500	10,144,500	1,877,000
National Railroad Passenger Corp.	29	6	385,300	385,300	509,300	124,000
Postal Service	29	1	950,000	950,000	950,000	-
Tennessee Valley Authority	29,30	13	4,329,800	4,329,800	5,503,900	1,174,100
Washington Metropolitan Area Transit Authority	30	1	2,494,600	2,494,600	4,500,000	2,005,400
TOTAL		269	$73,186,549	$75,779,475	$132,571,432	$56,791,957

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ESTIMATED COST DATA COMPARISON
FOR MAJOR CIVIL ACQUISITIONS

Agency and project	Original estimate Date	Original estimate Amount	Baseline estimate Date	Baseline estimate Amount	Current estimate Date	Current estimate Amount	Increase or decrease (-) from baseline estimate Amount	Increase or decrease (-) from baseline estimate Percent
		(000 omitted)						
APPALACHIAN REGIONAL COMMISSION:								
Appalachian Development Highway (app. III, p. 33)	1965	$840,000	1965	$840,000	1971	$2,090,000	$1,250,000	149
ARCHITECT OF THE CAPITOL								
Extension of Dirksen Office Building	1-74	68,800	1-74	68,800	11-74	85,122	16,322	24
Library of Congress, James Madison Building	3-70	90,000	3-70	90,000	6-74	90,000	-	-
Total		158,800		158,800		175,122	16,322	
ATOMIC ENERGY COMMISSION:								
Components Preparation Labs, Multiple Sites	12-71	26,000	12-71	26,000	8-73	30,000	4,000	15
Component Test Facility, Oak Ridge, Tenn.	12-71	21,200	12-71	21,200	1974	27,400	6,200	29
Fast Flux Test Facility (app. III, p. 33)	9-66	87,500	9-66	87,500	[a]12-73	420,000	332,500	380

ESTIMATED COST DATA COMPARISON
FOR MAJOR CIVIL ACQUISITIONS

Agency and project	Original estimate		Baseline estimate		Current estimate		Increase or decrease (-) from baseline estimate	
	Date	Amount	Date	Amount	Date	Amount	Amount	Percent
		(000 omitted)						
ATOMIC ENERGY COMMISSION: (Cont'd)								
Fire, Safety, and Adequacy of Operating Conditions Projects, Various Locations	12-70	$118,000	12-70	$118,000	1974	$193,000	$ 75,000	64
Gaseous Diffusion Production Support Facilities	4-71	95,000	4-71	95,000	1974	107,020	12,020	13
Liquid Metal Fast Breeder, Clinch River, Tenn.	8-72	422,000	8-72	422,000	b8-72	422,000	-	-
Nuclear Safety Engineering Test Facility, National Reactor Testing Station, Idaho	9-62	19,400	9-62	19,400	1974	36,600	17,200	89
Process Equipment Modifications Gaseous Diffusion Plants	12-71	523,000	12-71	523,000	1974	565,000	42,000	8
Restoration of Production Facilities at Rocky Flats	5-69	45,000	5-69	45,000	1974	40,558	-4,442	-10
S8G Prototype Propulsion Plant, W. Milton, N.Y.	3-72	125,000	3-72	125,000	3-72	125,000	-	-
Weapons Production Capabilities, Various Locations (app. III, p. 33)	12-66	32,300	12-66	32,300	8-74	310,100	277,800	860
200 BEV Accelerator, DuPage and Kane Counties, Ill.	12-67	250,000	12-67	250,000	12-67	250,000	-	-
Total		1,764,400		1,764,400		2,526,678	762,278	

ESTIMATED COST DATA COMPARISON
FOR MAJOR CIVIL ACQUISITIONS

Agency and project	Original estimate Date (note j)	Original estimate Amount	Baseline estimate Date (note k)	Baseline estimate Amount	Current estimate Date (note l)	Current estimate Amount	Increase or decrease (-) from baseline estimate Amount	Increase or decrease (-) from baseline estimate Percent
		(000 omitted)						
DEPARTMENT OF THE ARMY								
CORPS OF ENGINEERS:								
Flood Control:								
Alum Creek Lake, Ohio	1963	$ 22,700	1970	$35,500	7-73	$45,500	$10,000	28
B. Everett Jordan Dam and Lake, N.C. (app. III, p. 34)	1963	[g]25,462	1963	25,462	7-74	[g]74,600	49,138	193
Bear Creek Lake, Colo.	1968	32,314	1973	53,000	7-73	55,800	2,800	5
Beech Fork Lake, W. Va. (app. III, p. 34)	1962	11,000	1967	12,800	7-73	28,600	15,800	123
Big Darby Lake, Ohio (app. III, p.34)	1938	5,214	1965	27,200	7-73	78,100	50,900	187
Bloomington Lake, Md. and W. Va.	1962	51,000	1970	81,200	7-73	110,100	28,900	36
Blue Marsh Lake, Pa.	1962	12,500	1973	37,000	7-73	44,020	7,020	19
Brookville Lake, Ind.	1937	5,923	1965	27,200	7-73	34,900	7,700	28
Brunswick County Beaches, N.C.	1966	13,642	1973	19,000	7-73	27,200	8,200	43
Buffalo Bayou and Tributaries, Tex.	1954	[d]51,531	1960	[c]51,531	7-73	84,800	33,269	65
Burnsville Lake, W. Va.	1938	2,748	1971	30,700	7-73	39,700	9,000	29
Caesar Creek Lake, Ohio (app. III, p.34)	1938	3,595	1967	15,900	7-73	42,400	26,500	167
Carr Fork Lake, Ky. (app. III, p.34)	1962	9,020	1965	11,200	7-73	38,700	27,500	246
Central & Southern Fla.	1948	[d]237,500	1960	[c]237,500	7-73	473,000	235,500	99
Charles River Dam, Mass.	1968	18,620	1972	22,320	7-73	30,100	7,780	35

ESTIMATED COST DATA COMPARISON
FOR MAJOR CIVIL ACQUISITIONS

Agency and project	Original estimate Date (note j)	Original estimate Amount	Baseline estimate Date (note k)	Baseline estimate Amount	Current estimate Date (note l)	Current estimate Amount	Increase or decrease (-) from baseline estimate Amount	Percent
				(000 omitted)				
Flood Control: (Cont'd)								
Chartiers Creek, Pa.	1965	$ 12,207	1968	$14,400	7-73	$25,900	$11,500	80
Chatfield Lake, Colo.	1950	[d]34,200	1967	74,000	7-73	83,800	9,800	13
Chena River Lakes, Alaska	1968	111,700	1973	100,000	7-73	122,000	22,000	22
Clayton Lake, Okla.	1962	13,174	1973	21,800	7-73	31,000	9,200	42
Clinton Lake, Kans.	1962	25,200	1972	44,200	7-73	50,800	6,600	15
Cochite Lake, N. Mex.	1960	43,400	1965	50,000	7-73	90,800	40,800	82
Cooper Lake & Channels, Tex. (app. III, p. 34)	1955	[e]15,200	1961	[e]15,200	7-73	50,600	35,400	233
Copan Lake, Okla.	1962	25,578	1971	42,400	7-73	57,100	14,700	35
Cowanesque Lake, Pa.	1958	28,455	1973	53,500	7-73	58,900	5,400	10
Dry Creek Lake, Calif. (app. III, p. 34)	1962	42,400	1967	51,000	7-73	113,000	62,000	122
East Fork Lake, Ohio	1938	4,450	1967	25,560	7-73	37,100	11,540	45
East Lynn Lake, W. Va. (app. III, p.34)	1937	[f]14,300	1965	14,300	7-73	31,000	16,700	117
Eldorado Lake, Kans.	1965	23,300	1971	29,300	7-73	58,300	29,000	99
Elk Creek Lake, Oreg.	1962	17,467	1971	27,200	7-73	42,400	15,200	56
Falls Lake, N.C.	1965	18,600	1971	29,600	7-73	59,100	29,500	99
Fire Island Inlet to Montauk Pt., N.Y. (app. III, p.34)	1960	19,700	1963	19,700	7-73	54,000	34,300	174
Four Rivers Basins, Fla.	1962	56,261	1966	56,300	7-73	106,000	49,700	88

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FOR MAJOR CIVIL ACQUISITIONS

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Flood Control: (Cont'd)								
Gathright Lake, Va. (app. III, p. 34)	1946	[d]$13,000	1967	$16,300	7-73	$49,800	$33,500	206
Gila River, Downstream from Painted Rock, Ariz.	1962	18,400	1971	32,800	7-73	43,800	11,000	34
Hidden Lake, Calif.	1962	14,338	1968	17,400	7-73	25,900	8,500	49
Hillsdale Lake, Kans.	1954	[d]9,400	1973	37,300	7-73	43,700	6,400	17
Hugo Lake, Okla.	1946	[d]20,400	1967	22,600	7-73	35,600	13,000	58
Kansas City, Kans.	1962	17,833	1970	24,300	7-73	41,700	17,400	72
Kaw Lake, Okla.	1962	83,230	1966	86,600	7-73	111,000	24,400	28
Lafarge Lake and Channel Improvement, Wis.	1962	15,570	1971	24,100	7-73	35,100	11,000	46
Lafayette Lake, Ind.	1965	26,400	1971	38,000	7-73	61,200	23,200	61
Lake Ponchartrain and Vicinity, La. (app. III, p. 34)	1965	56,235	1967	65,784	7-73	203,000	137,216	209
Lake Shelbyville, Ill. (app. III, p. 34)	1958	[e]18,500	1961	[e]18,500	7-73	44,000	25,500	138
Lavon Lake Modification and East Fork Channel Improvements, Tex. (app. III, p. 34)	1962	23,760	1967	27,300	7-73	59,500	32,200	118
Lincoln Lake, Ill.	1965	30,720	1971	39,900	7-73	72,000	32,100	80
Los Angeles County Drainage Area, Calif.	1936	[d]338,000	1960	[c]338,000	7-73	322,000	-16,000	- 5
Meramec Park Lake, Mo.	1938	[f]79,100	1973	79,100	7-73	93,000	13,900	18
Missouri River Levee System (app. III, p. 34)	1928	[f]60,600	1962	60,600	7-73	147,800	87,200	144

ESTIMATED COST DATA COMPARISON
FOR MAJOR CIVIL ACQUISITIONS

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		(000 omitted)						
Flood control: (Cont'd)								
Napa River, Calif.	1965	$14,950	1970	$18,190	7-73	$27,400	$9,210	51
New Orleans to Venice Hurricane Protection, La. (app. III, p. 34)	1962	7,502	1964	7,580	7-73	74,900	67,320	888
Optima Lake, Okla.	1936	[f]23,100	1966	23,100	7-73	39,800	16,700	72
Paint Creek Lake, Ohio	1938	3,835	1965	23,800	7-73	25,800	2,000	8
Paintsville Lake, Ky.	1965	16,974	1971	22,700	7-73	32,900	10,200	45
Papillion Creek, Nebr. (app. III, p. 35)	1968	26,800	1972	38,000	7-73	78,500	40,500	107
Port Arthur and Vicinity, Tex.	1962	23,380	1966	40,600	7-73	56,300	15,700	39
R.D. Bailey Lake, W. Va.	1962	60,477	1967	82,600	7-73	127,200	44,600	54
Raystown Lake, Pa.	1962	32,150	1967	53,500	7-73	69,400	15,900	30
Red River Lake, Ky. (app. III, p. 35)	1962	8,020	1967	10,700	7-73	27,600	16,900	158
Red River Levees and Bank Stabilization (app. III, p. 35)	1946	[e]10,000	1961	[e]10,000	7-73	34,000	24,000	240
Rend Lake, Ill.	1962	27,600	1965	35,000	7-73	44,700	9,700	28
Ririe Lake, Idaho	1962	7,072	1967	13,100	7-73	25,000	11,900	91
River Rouge, Mich. (app. III, p. 35)	1962	8,659	1963	9,620	7-73	26,100	16,480	171
Sacramento River Bank Protection, Calif. (app. III, p. 35)	1960	14,240	1963	15,100	7-73	64,200	49,100	325

ESTIMATED COST DATA COMPARISON
FOR MAJOR CIVIL ACQUISITIONS

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Flood Control: (Cont'd)								
Saginaw River, Mich. (app. III, p.35)	1958	[f]$16,200	1963	$16,200	7-73	$45,766	$29,566	183
San Antonio Channel Improvement, Tex. (app. III, p. 35)	1954	[d]15,870	1960	[c]15,870	7-73	35,100	19,230	121
San Gabriel Rivers, Tex.	1962	45,450	1973	87,800	7-73	96,500	8,700	10
Saylorville Lake, Iowa	1958	44,500	1964	36,500	7-73	72,500	36,000	99
Skiatook Lake, Okla.	1962	22,875	1973	42,500	7-73	50,500	8,000	19
Smithville Lake, Mo.	1965	21,500	1972	39,000	7-73	58,800	19,800	51
Southwestern Jefferson County, Ky.	1968	21,940	1973	26,800	7-73	31,100	4,300	16
Stonewall Jackson Lake, W. Va.	1966	34,500	1971	45,200	7-73	87,500	42,300	94
Tallahala Creek Lake, Miss.	1968	13,800	1973	19,200	7-73	31,300	12,100	63
Taylorsville Lake, Ky.	1966	21,840	1971	29,100	7-73	43,100	14,000	48
Texas City and Vicinity, Tex. (app. III, p. 35)	1958	[d]6,240	1962	6,670	7-73	45,300	38,630	579
Tioga-Hammond Lakes, Pa.	1958	53,575	1971	88,200	7-73	121,700	33,500	38
Tombigbee River and Tributaries, Miss. and Ala. (app. III, p. 35)	1958	[g]19,311	1958	19,311	7-74	[g]53,300	33,989	176
Trinidad Lake, Colo.	1958	[d]19,200	1968	21,600	7-73	36,400	14,800	69
Walnut Creek, Calif.	1960	17,980	1964	21,300	7-73	32,700	11,400	54
Waterloo, Iowa	1965	14,900	1970	17,200	7-73	26,900	9,700	56
Waurika Lake, Okla.	1963	25,100	1970	37,500	7-73	59,100	21,600	58

ESTIMATED COST DATA COMPARISON
FOR MAJOR CIVIL ACQUISITIONS

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		(000 omitted)						
Flood Control: (Cont'd)								
Yatesville Lake, Ky.	1965	$20,007	1973	$28,800	7-73	$40,500	$11,700	41
Subtotal		2,553,394		3,286,898		5,390,286	2,103,388	
Mississippi River and Tributaries:								
Atchafalaya Basin, La. (app. III, p. 36)	1927	[e]120,000	1961	[e]120,000	7-73	661,000	541,000	451
Lower Red River South Bank (app. III, p.36)	1927	[d]8,990	1960	[c]8,990	7-73	26,400	17,410	194
Mississippi River Cache Basin (app. III, p.36)	1949	[d,g] 25,000	1960	25,000	7-73	[g]68,700	43,700	175
Mississippi River Channel Improvements (app. III, p. 36)	1927	[d]468,000	1960	[c]468,000	7-73	1,831,000	1,363,000	291
Mississippi River Levees (app. III, p.36)	1927	[d]221,000	1960	[c]221,000	7-73	688,000	467,000	211
Mississippi River Tensas Basin, La. (app. III, p. 36)	1940	[e]31,700	1961	[e]31,700	7-73	186,500	154,800	488
Mississippi River Yazoo Basin (app. III, p.36)	1935	[e]195,000	1961	[e]195,000	7-73	409,000	214,000	110
Mississippi River West Tennessee Tributaries (app. III, p. 36)	1947	[d]8,400	1960	[c]8,400	7-73	28,747	20,347	242
Mississippi River St. Francis Basin (app. III, p. 36)	1935	[e]88,200	1961	[e]88,200	7-73	233,000	144,800	164

ESTIMATED COST DATA COMPARISON
FOR MAJOR CIVIL ACQUISITIONS

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Mississippi River and Tributaries: (Cont'd)								
Old River Control, La.	1953	[d]$80,000	1960	[c]$80,000	7-73	$79,000	$-1,000	-1
Subtotal		1,246,290		1,246,290		4,211,347	2,965,057	
Multipurpose Projects Including Power:								
Big Bend-Lake Sharp, S. Dak.	1944	[d]137,000	1960	[c]137,000	7-73	107,350	-29,650	-22
Bonneville Lock and Dam, Oreg and Wash. (Modification for peaking) (app. III, p. 37)	1933	[m]11,900	1970	13,500	7-73	37,800	24,300	180
Bonneville Second Powerhouse, Oreg. and Wash.	1937	[h]108,100	1974	267,000	7-73	296,000	29,000	11
Carters Lake, Ga. (app. III, p. 37)	1945	[d]38,000	1962	38,000	7-73	106,000	68,000	179
Chief Joseph Dam, Rufus Woods Lake, Wash.	1946	[d]57,500	1973	167,000	7-73	211,000	44,000	26
Clarence Cannon Dam, Mo. (app. III, p. 37)	1962	[g]63,300	1962	63,300	7-73	[g]152,300	89,000	141
Cordell Hull Dam and Res., Tenn.	1946	19,900	1963	39,900	7-73	75,500	35,600	89

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Multipurpose Projects Including Power: (Cont'd)								
Cougar Lake, Oreg.	1950	[d]$42,900	1960	[c]$42,900	7-73	$56,900	$14,000	33
Dalles Lock and Dam, Wash. and Oreg.	1950	[d]53,173	1967	64,000	7-73	66,000	2,000	3
DeGray Lake, Ark. (app. III, p. 37)	1950	[f]32,500	1962	32,500	7-73	65,500	33,000	102
Dworshak Dam and Lake, Idaho.	1962	127,166	1963	186,000	7-73	302,000	116,000	62
Garrison Dam and Lake, Sakakawra, N. Dak.	1944	[d]294,000	1960	[c]294,000	7-73	293,900	-100	0
Harry S. Truman Dam and Res., Mo. (app. III, p. 37)	1954	[d]102,000	1965	146,200	7-73	332,000	185,800	127
Ice Harbor Lock and Dam, Lake Sacajawea, Wash.	1945	[d]20,000	1971	26,400	7-73	35,300	8,900	34
John Day Lock and Dam, Oreg. and Wash.	1950	[d]387,000	1960	[c]387,000	7-73	485,000	98,000	25
Jones Bluff Lock and Dam, Ala.	1945	[d]52,600	1966	52,600	7-73	73,900	21,300	40
Laurel River Lake, Ky.	1960	21,900	1965	22,700	7-73	40,400	17,700	78
Libby Dam and Lake Koocanusa, Mont.	1950	[d]308,000	1966	349,000	7-73	466,000	117,000	34
Little Goose Additional Units, Wash.	1945	[d]20,000	1974	34,100	7-73	37,800	3,700	11

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Multipurpose Projects Including Power: (Cont'd)								
Little Goose Lock and Dam, Wash.	1945	d$139,000	1963	$144,000	7-73	$165,800	$21,800	15
Lost Creek Lake, Oreg.	1962	74,540	1967	83,100	7-73	127,000	43,900	53
Lower Granite Add. Units, Wash.	1945	d20,000	1974	34,100	7-73	37,800	3,700	11
Lower Granite Lock and Dam, Wash.	1945	d118,000	1965	174,000	7-73	298,000	124,000	71
Lower Monumental Lock and Dam, Wash.	1945	d138,000	1961	151,000	7-73	187,000	36,000	24
Lytle and Warm Creeks, Calif.	1965	9,750	1971	13,000	7-73	25,600	12,600	97
McNary Lock and Dam, Oreg. and Wash.	1945	d236,400	1960	c236,400	7-73	301,500	65,100	28
New Melones Lake, Calif. (app. III, p. 37)	1962	113,717	1966	122,000	7-73	257,000	135,000	111
Oahe Dam, Lake Oahe, S. Dak. and N. Dak.	1944	d380,000	1960	c380,000	7-73	345,200	-34,800	-9
Ozark Lock and Dam, Ark. (app. III, p.37)	1946	d36,300	1965	36,300	7-73	84,500	48,200	133
Pine Flat Lake and Kings River, Calif.	1944	19,700	1960	c41,200	7-73	41,600	400	1
Snettisham Power Project, Alaska (app. III, p.37)	1962	41,634	1967	41,500	7-73	85,600	44,100	106

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Multipurpose Projects Including Power: (Cont'd)								
Spewrell Bluff Lake, Ga.	1963	$63,200	1971	$91,800	7-73	$148,000	$56,200	61
Tocks Island Lake, Pa., N.J., and N.Y.	1962	90,400	1971	259,000	7-73	360,575	101,575	39
Webbers Falls Lock and Dam, Okla.	1946	[d]60,400	1965	63,200	7-73	83,300	20,100	32
West Point Lake, Ga. and Ala. (app. III, p. 37)	1962	52,900	1965	53,000	7-73	112,095	59,095	112
Wolf Creek Dam, Lake Cumberland, Ky.		[f]64,000	1974	64,000	7-73	64,000	-	-
Subtotal		3,554,880		4,350,700		5,965,220	1,614,520	
Navigation:								
Cannelton Locks and Dam, Ind. and Ky.	1960	68,400	1962	71,700	7-73	98,900	27,200	38
Columbia and Lower Williamette River, Oreg. and Wash.	1962	20,100	1964	21,400	7-73	26,600	5,200	24
Corpus Christi Ship Channel, Tex.	1968	19,402	1972	20,400	7-73	26,600	6,200	30
Cross Florida Barge Canal, Fla.	1942	[d]165,000	1964	145,300	7-73	[i]179,000	33,700	23

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Navigation: (Cont'd)								
Delaware River - Philadelphia to Sea Anchorage, N.J.	1958	[d]$28,100	1963	$28,100	7-73	$37,300	$9,200	33
Delaware River - Philadelphia to Trenton, Pa. and N.J.	1954	100,290	1960	[c]80,420	7-73	76,508	-3,912	-5
Great Lakes Connecting Channels, Mich.	1946	10,982	1960	[c]146,500	7-73	145,000	-1,500	-1
Hampton Roads, Va.	1965	28,900	1966	32,700	7-73	33,000	300	1
Hannibal Locks and Dam, Ohio and W. Va.	1961	55,909	1966	66,700	7-73	86,000	19,300	29
Illinois Waterway - Calumet-Sag Modification: Pt. I, Ill. and Ind.	1945	21,390	1960	[c]92,500	7-73	91,100	-1,400	-2
Inland Waterway - Dela. River to Chesapeake Bay, Pt. II, Del. and Md.	1954	101,000	1962	98,840	7-73	109,730	10,890	11
Jacksonville Harbor, Fla. (app. III, p. 38)	1965	8,484	1968	8,800	7-73	34,500	25,700	292
Kaskaskia River, Ill.	1962	58,200	1966	66,200	7-73	112,000	45,800	69
McClellan-Kerr Ark. River Bank Stabilization	1946	[d]102,800	1960	[c]102,800	7-73	130,000	27,200	26
McClellan-Kerr Ark. River Locks and Dams	1946	[d]459,000	1963	449,000	7-73	497,200	48,200	11

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Navigation: (Cont'd)								
Mississippi River Between Ohio-Missouri Rivers :								
Chain of Rocks, Ill.	1945	[d]$40,150	1960	[c]$40,150	7-73	$57,700	$17,550	44
Regulating Works, Ill.and Mo.	1910	[d]61,900	1960	[c]61,900	7-73	81,000	19,100	31
Mississippi River Gulf Outlet, La. (app. III, p. 38)	1956	[d]101,000	1961	[e]105,000	7-73	276,000	171,000	163
Missouri River Sioux City to Mouth	1912	[d]349,000	1960	[c]349,000	7-73	450,000	101,000	29
Newburgh Locks and Dam, Ind. and Ky.	1962	58,400	1965	62,000	7-73	94,700	32,700	53
New York Harbor - Anchorage, N.Y.	1965	44,852	1968	45,000	7-73	34,900	-10,100	-22
Ouachita and Black Rivers, Ark. and La. (app. III, p. 38)	1960	43,550	1963	45,500	7-73	146,150	100,650	221
Red River Waterway (Miss. River to Shreveport, La., Ark. and Okla.)	1968	148,104	1973	442,000	7-73	473,000	31,000	7
San Francisco Bay to Stockton, Calif.	1965	46,853	1970	54,700	7-73	76,790	22,090	40
Smithland Locks and Dam, Ill. and Ky.	1965	90,000	1970	110,000	7-73	192,000	82,000	75
Uniontown Locks and Dam, Ind. and Ky.	1958	51,100	1965	61,700	7-73	95,700	34,000	55

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Navigation: (Cont'd)								
Wallisville Lake, Tex. (app. III, p. 38)	1962	$ 9,162	1966	$ 9,920	7-72	$28,800	$18,880	190
Weymouth-Fore and Town Rivers, Ma. (app. III, p. 38)	1965	12,500	1968	12,500	7-73	25,000	12,500	100
Willow Island Locks and Dam, Ohio and W. Va.	1963	66,400	1965	70,300	7-73	73,300	3,000	4
Subtotal		2,370,928		2,901,030		3,788,478	887,448	
Total		9,725,492		11,784,918		19,355,331	7,570,413	
DEPARTMENT OF INTERIOR:								
Bonneville Power Administration:								
Chief Joseph Integrating Transmission Facility	2-67	31,300	2-67	31,300	1974	35,100	3,800	12
Grand Coulee-Raver Transmission Lines	2-72	55,000	2-72	55,000	1974	78,490	23,490	43
Lower Snake Transmission Facilities	2-67	40,800	2-67	40,800	1974	38,740	-2,060	-5
Subtotal		127,100		127,100		152,330	25,230	

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Bureau of Reclamation:								
Central Arizona Project:								
Irrigation	1968	$716,980	1968	$716,980	1974	$1,078,000	$361,020	50
Navajo Participation Agreement (power plant)	1968	115,200	1968	115,200	1974	197,000	81,800	71
Central Valley:								
Auburn-Folsom South Unit (water control), Calif.	1965	425,000	1965	425,000	1974	657,676	232,676	55
Sacramento River Div. (irrigation), Calif.	1950	[q]111,365	1950	111,365	1974	208,008	96,643	87
San Luis Unit (water control), Calif.	1960	490,280	1960	490,280	1974	689,613	199,333	41
Columbia Basin:								
Irrigation Facilities	1935	[q]925,103	1935	925,103	1974	1,583,163	658,060	71
Third Power Plant	1966	390,000	1966	390,000	1974	458,000	68,000	17
Fryingpan Arkansas Project Colorado (water control) (app. III, p. 39)	1962	170,000	1962	170,000	1974	460,632	290,632	171
Mountain Park Project (water control), Okla.	1968	19,978	1968	19,978	1974	26,965	6,987	35
Navajo Indian Irrigation Project (note p)	[r]1970	206,000	1970	206,000	1974	281,000	75,000	36
Pacific Northwest--Pacific Southwest Intertie (transmission lines), Ariz., Calif, and Nev.	1964	130,630	1964	130,630	1974	223,144	92,514	71

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ESTIMATED COST DATA COMPARISON
FOR MAJOR CIVIL ACQUISITIONS

Agency and project	Original estimate Date	Original estimate Amount	Baseline estimate Date	Baseline estimate Amount	Current estimate Date	Current estimate Amount	Increase or decrease (-) from baseline estimate Amount	Increase or decrease (-) from baseline estimate Percent
		(000 omitted)						
Bureau of Reclamation: (Cont'd)								
Palmetto Bend Project (water control construction), Tex.	1968	$36,800	1968	$36,800	1974	$54,660	$17,860	49
Pick-Sloan Missouri River Basin Program:								
Garrison Diversion Unit	1965	207,000	1965	207,000	1974	363,000	156,000	75
Oahe Unit (water control) S. Dak.	1968	191,670	1968	191,670	1974	315,000	123,330	64
Transmission Division (note n)	[r] 1972	384,403	1972	384,403	1974	384,403	-	-
Southern Nevada Water Project (drainage), Nev.	1965	81,003	1965	81,003	1974	99,300	18,297	23
Teton Basin, Lower Teton Division (water control), Idaho	1964	52,000	1964	52,000	1974	89,965	37,965	73
Tualatin Project (water control), Oreg.	1966	20,900	1966	20,900	1974	40,843	19,943	95
Upper Colorado River Storage Project:								
Central Utah Participation Project, Utah (note o)	[r] 1972	420,346	1972	420,346	1974	449,566	29,220	7
Central Utah Project, Recreation, Fish & Wildlife for Bonneville (note o)	[r] 1972	19,981	1972	19,981	1974	28,079	8,098	41

ESTIMATED COST DATA COMPARISON
FOR MAJOR CIVIL ACQUISITIONS

Agency and project	Original estimate Date	Original estimate Amount	Baseline estimate Date	Baseline estimate Amount	Current estimate Date	Current estimate Amount	Increase or decrease (-) from baseline estimate Amount	Increase or decrease (-) from baseline estimate Percent
		(000 omitted)						
Bureau of Reclamation: (Cont'd)								
Curecanti Unit, Colo. (note o)	[r]1972	$129,356	1972	$129,356	1974	$129,501	$ 145	-
San Juan-Chama Participating Project	1962	85,828	1962	85,828	1974	93,271	7,443	9
Transmission Division (note o)	[r]1972	219,553	1972	219,553	1974	220,292	739	-
Washoe Project (drainage), Calif. and Nev.	1956	[q]50,452	1956	50,452	1974	67,363	16,911	34
Subtotal		5,599,828		5,599,828		8,198,444	2,598,616	
Total		5,726,928		5,726,928		8,350,774	2,623,846	
DEPARTMENT OF TRANSPORTATION:								
Federal Aviation Administration:								
Long Range Radars	4-74	76,050	4-74	76,050	1974	76,050	-	-
Building Expansion	4-71	34,000	4-71	34,000	1974	34,000	-	-
ARTS III (Automated Radar Terminal Systems)	6-67	33,000	6-67	33,000	1974	64,500	31,500	95
Aircraft and Related Equipment	2-72	57,450	2-72	57,450	1974	57,482	32	-
National Airspace Systems Stage A (app. III, p.39)	10-65	212,000	10-65	212,000	1974	618,600	406,600	192
Subtotal		412,500		412,500		850,632	438,132	

ESTIMATED COST DATA COMPARISON
FOR MAJOR CIVIL ACQUISITIONS

Agency and project	Original estimate Date	Original estimate Amount	Baseline estimate Date	Baseline estimate Amount	Current estimate Date	Current estimate Amount	Increase or decrease (-) from baseline estimate Amount	Increase or decrease (-) from baseline estimate Percent
	(000 omitted)							
Federal Highway Administration:								
Darien Gap Highway	[s]1970	$150,000	1970	$150,000	12-73	$150,000	$ -	-
Interstate Highway System (app. III, p. 39) (note u)	1958	37,600,000	1958	37,600,000	[t]1972	76,300,000	38,700,000	103
Subtotal		37,750,000		37,750,000		76,450,000	38,700,000	
Urban Mass Transportation Administration:								
Development of New Transit Bus	4-72	22,180	4-72	22,180	7-74	27,900	5,720	26
Dual Mode Transit System	4-72	23,500	4-72	23,500	7-74	25,000	1,500	6
Morgantown Personal Rapid Transit System (app. III, p. 39)	5-71	28,300	5-71	28,300	3-73	64,300	36,000	127
Urban Rapid Rail Vehicles and Systems Program (app. III, p. 39)	4-72	11,029	4-72	11,029	7-74	26,329	15,300	139
Subtotal		85,009		85,009		143,529	58,520	
U.S. Coast Guard:								
Polar Sea	9-73	66,000	9-73	66,000	12-73	66,000	-	-
Polar Star	6-71	59,000	6-71	59,000	12-73	59,000	-	-
Subtotal		125,000		125,000		125,000		
Total		38,372,509		38,372,509		77,569,161	39,196,652	

ESTIMATED COST DATA COMPARISON
FOR MAJOR CIVIL ACQUISITIONS

Agency and project	Original estimate Date	Original estimate Amount	Baseline estimate Date	Baseline estimate Amount	Current estimate Date	Current estimate Amount	Increase or decrease (-) from baseline estimate Amount	Increase or decrease (-) from baseline estimate Percent
		(000 omitted)						
DEPARTMENT OF THE TREASURY:								
Denver Mint	1973	$50,000	1973	$50,000	1974	[v]$55,300	$5,300	11
DISTRICT OF COLUMBIA GOVERNMENT:								
Correctional Detention Center	FY 70	30,500	FY 70	30,500	FY 70	30,500	-	-
New Courthouse Building	FY 69	45,400	FY 69	45,400	FY 69	45,400	-	-
Local Flooding Relief and Storm Drainage:								
a) Capitol Hill Relief	FY 69	25,100	FY 69	25,100	FY 69	25,100	-	-
b) N.E. Boundary Relief Sewer	FY 69	37,100	FY 69	37,100	FY 69	37,100	-	-
Washington Technical Institute	FY 68	111,000	FY 68	111,000	FY 68	111,000	-	-
Federal City College	FY 74	128,900	FY 74	128,900	FY 74	128,900	-	-
Lorton Renovation Program	FY 72	65,200	FY 72	65,200	FY 72	65,200	-	-
Total		443,200		443,200		443,200	-	
GENERAL SERVICES ADMINISTRATION:								
Beltsville Consolidated Federal Law Enforcement Training Center (app. III, p. 40)	1-69	18,073	1-69	18,073	w	74,395	56,322	312
Cincinnati Environmental Control Administration Laboratory	1969	27,837	1969	27,837	12-73	25,284	-2,553	-9
Howard University Teaching Hospital	1970	23,430	1970	23,430	5-71	43,000	19,570	84
J. Edgar Hoover FBI Building (app. III, p. 40)	3-62	60,000	3-62	60,000	12-73	126,108	66,108	110

ESTIMATED COST DATA COMPARISON
FOR MAJOR CIVIL ACQUISITIONS

Agency and project	Original estimate Date	Original estimate Amount (note x)	Baseline estimate Date	Baseline estimate Amount (note y)	Current estimate Date	Current estimate Amount	Increase or decrease (-) from baseline estimate Amount	Percent
		(000 omitted)						
GENERAL SERVICES ADMINISTRATION: (cont'd)								
Philadelphia Federal Office Building (app. III, p. 40)	6-71	$42,680	6-71	$42,680	12-73	$87,479	$44,799	105
Smithsonian Institution National Air and Space Museum	1962	39,500	1962	39,500	12-73	41,900	2,400	6
Total		211,520		211,520		398,166	186,646	
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION:								
Apollo Soyuz Test Project	3-72	[z]250,000	6-72	[z]250,000	2-74	[z]250,000	-	-
Applications Technology Satellite (ATS-F)	4-67	[aa,bb]98,700	1-71	[aa] 230,000	2-74	205,600	-24,400	-11
Atmosphere Explorer (C thru E)	12-69	[bb]50,400	9-71	59,400	5-74	69,600	10,200	17
Earth Resources Technology Satellite 1 and B	12-69	[bb]87,100	11-70	154,400	2-74	196,600	42,200	27
High Energy Astronomy Observatory	2-74	232,800	2-74	232,800	2-74	232,800	-	-
International Sun-Earth Explorers	2-74	50,700	2-74	50,700	2-74	50,700	-	-
International Ultra-violet Explorer	9-71	34,200	9-71	34,200	2-74	35,000	800	2
Mariner Jupiter/Saturn 1977	7-72	[bb]377,900	5-74	371,200	5-74	371,200	-	-
Mariner Venus/Mercury 1973	2-69	[bb]96,800	12-69	112,000	9-73	118,500	6,500	6
Nimbus 5 and F	4-67	[bb]91,800	4-70	95,200	2-74	115,600	20,400	21
Nimbus G	2-73	81,800	2-73	81,800	2-74	82,500	700	1

ESTIMATED COST DATA COMPARISON
FOR MAJOR CIVIL ACQUISITIONS

Agency and project	Original estimate Date	Original estimate Amount (note x)	Baseline estimate Date	Baseline estimate Amount (note y)	Current estimate Date	Current estimate Amount	Increase or decrease (-) from baseline estimate Amount	Increase or decrease (-) from baseline estimate Percent
		(000 omitted)						
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION: (Cont'd)								
Ocean Dynamics Satellite (SEASAT-A)	2-74	[dd]$60,600	2-74	[cc]$60,600	2-74	[dd]$60,600	$ -	-
Orbiting Solar Observatory 1	5-71	[bb]47,400	5-72	50,000	2-74	62,800	12,800	26
Pioneer 10/11	2-69	[bb]92,200	11-70	129,900	2-74	131,000	1,100	1
Pioneer Venus	2-74	207,100	2-74	207,100	2-74	207,100	-	-
Quiet, Clean, Short Haul Experimental Engine	3-72	59,900	6-73	33,800	2-74	33,900	100	-
Radio Astronomy Explorer	8-69	25,700	8-72	27,600	3-74	28,300	700	3
Refran (JT8D Engines)	3-72	55,000	4-73	44,000	2-74	44,000	-	-
Small Astronomy Satellite	4-70	[bb]42,400	8-71	45,900	3-74	51,000	5,100	11
Synchronous Meteorological Satellite 1 and B	2-69	[bb]23,600	5-71	37,200	2-74	65,800	28,600	77
Space Transportation System (Space Shuttle -RDT and E only)	3-72	5,150,000	3-72	5,150,000	12-73	6,680,600	1,530,600	30
Tiros-N	1-72	56,700	1-72	56,700	2-74	53,400	-3,300	-6
Viking '75	2-69	[bb]461,200	10-69	753,000	4-74	997,900	244,900	33
Total		7,734,000		8,267,500		10,144,500	1,877,000	

ESTIMATED COST DATA COMPARISON
FOR MAJOR CIVIL ACQUISITIONS

Agency and project	Original estimate Date	Original estimate Amount	Baseline estimate Date	Baseline estimate Amount	Current estimate Date	Current estimate Amount	Increase or decrease (-) from baseline estimate Amount	Increase or decrease (-) from baseline estimate Percent
		(000 omitted)						
NATIONAL RAILROAD PASSENGER CORPORATION:								
Bi-Level Coaches	11-73	$90,000	11-73	$90,000	3-74	$168,000	$78,000	87
Low-Level Coaches	3-74	160,000	3-74	160,000	3-74	160,000	-	-
Metro-type Cars (note ee)	11-73	23,800	11-73	23,800	3-74	23,800	-	-
Turbine Cars (app. III, p. 40)	11-73	35,000	11-73	35,000	3-74	70,000	35,000	100
Diesel Locomotives	11-73	68,300	11-73	68,300	3-74	79,300	11,000	16
Electric Locomotives (note ee)	11-73	8,200	11-73	8,200	3-74	8,200	-	-
Total		385,300		385,300		509,300	124,000	
POSTAL SERVICE:								
National Bulk Mail System	3-71	950,000	3-71	950,000	6-74	950,000	-	-
TENNESSEE VALLEY AUTHORITY:								
Bear Creek Water Control System	1-65	24,000	1-65	24,000	9-73	ff 42,000	18,000	75
Bellefonte Nuclear Plant Units 1 and 2	1-71	650,000	1-71	650,000	9-72	725,000	75,000	12
Brown's Ferry Nuclear Plant Units 1 - 3	1-68	392,000	1-68	392,000	9-73	750,000	358,000	91
Cumberland Steam Plant Units 1 and 2	1-68	325,000	1-68	325,000	9-73	410,000	85,000	26

ESTIMATED COST DATA COMPARISON
FOR MAJOR CIVIL ACQUISITIONS

Agency and project	Original estimate Date	Original estimate Amount	Baseline estimate Date	Baseline estimate Amount	Current estimate Date	Current estimate Amount	Increase or decrease (-) from baseline estimate Amount	Increase or decrease (-) from baseline estimate Percent
		(000 omitted)						
TENNESSEE VALLEY AUTHORITY: (Cont'd)								
Duck River Project:								
Columbia Dam and Reservoir	6-69	$50,000	6-69	$50,000	9-69	$53,500	$ 3,500	7
Normandy Dam and Reservoir	6-69	23,500	6-69	23,500	9-73	35,000	11,500	49
Hartsville Nuclear Plant Units 1-4	1-73	1,575,000	1-73	1,575,000	1-73	1,575,000	-	-
Modernization and Installation of Electrostatic Precipitators and Stacks (note gg)	various	220,800	various	220,800	various	260,400	39,600	18
Raccoon Mt. Storage Project Units 1-4	1-70	155,000	1-70	155,000	9-72	192,000	37,000	24
Sequoyah Nuclear Plant	1-69	336,000	1-69	336,000	1-74	650,000	314,000	93
SO_2 Scrubbers-Widows Creek Unit-8	1-72	36,000	1-72	36,000	hh	42,000	6,000	17
Tellico Dam and Reservoir	1-65	42,500	1-65	42,500	1-70	69,000	26,500	60
Watts Bar Nuclear Plant Units 1 and 2	1-70	500,000	1-70	500,000	9-73	700,000	200,000	40
Total		4,329,800		4,329,800		5,503,900	1,174,100	
WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY:								
Subway System	2-69 [ii]	2,494,600	2-69	2,494,600	11-74 [ii]	4,500,000	2,005,400	80
GRAND TOTAL		$73,186,549		$75,779,475		$132,571,432	$56,791,957	

[a]Current program estimate is $933 million; however, this includes supporting costs. Details of supporting costs for original estimates were not available.

[b]Utility companies and reactor manufacturers will contribute about $277 million to make total project estimates of $699 million. An indicated later estimate is $1.7 billion.

[c]Initial detailed estimate was made before fiscal year 1960; therefore, fiscal year 1960 estimate is used.

[d]Fiscal year 1960 estimate; initial date (fiscal year) of authorization is given.

[e]Authorization and initial detailed estimates were made before fiscal year 1960; fiscal year 1961 estimates were earliest ones available.

[f]Baseline estimate used since authorization amount not furnished.

[g]Cost breakdown on this project was made between the original estimate and the current estimate instead of a later baseline.

[h]Congressional authorization was for 1965, but actual pre-1960 authorization date is used.

[i]Suspended by the President in fiscal year 1971; environmental studies underway.

[j]Year of authorization; in most cases estimate was made by the Corps 1 or 2 years before authorization.

[k]Fiscal year of baseline; in most cases estimate was made by the Corps in previous July.

[l]Fiscal year 1975 estimate in most cases. However, the Corps of Engineers furnished us higher current estimates than shown in fiscal year 1975 hearings for about 10 projects.

[m]July 1965 estimate.

[n]Represents a portion of the total estimated cost authorized under Public Law 92-371.

[o]Represents a portion of the total estimated cost authorized under Public Law 92-370.

[p]Bureau of Indian Affairs project.

[q]Estimate originated before 1960; the estimate shown is for 1960.

[r]Estimates reflect most recent reauthorized amounts.

[s]Total cost estimate of $150 million is unchanged in FY 75 House Appropriations hearings. Federal Aid Highway Act of 1970 set $100 million or two-thirds of the total cost as the maximum Federal share.

[t]Next estimate will be prepared in 1975.

[u]Federal share is 90 percent, or $33.9 billion and $68.26 billion, respectively.

[v]FY 1975 appropriation hearings.

[w]Prospectus pending at 10-74.

[x]National Aeronautics and Space Administration's planning estimate.

[y]Development estimate or planning estimate in absence of a development estimate on National Aeronautics and Space Administration projects.

[z]Launch vehicle not included.

[aa]Includes both ATS-F&G satellites. ATS-G canceled in Jan. 1973.

[bb]Adjusted to real-year dollars.

[cc]Development estimate to be available in FY 76 congressional budget.

[dd]Figure is the high end of $40,600 to $60,600 estimate.

[ee]Although below $25 million, these items are included since they are a part of National Railroad Passenger Corporation's Capital Acquisition Program.

[ff]Per 1975 appropriation hearings, Apr. 1974, House Public Works Subcommittee.

[gg]Under construction and planned for FY 1974 and beyond at various locations.

[hh]Not furnished by the Tennessee Valley Authority.

[ii]Federal share remains at $1,147 million, the original estimate.

ANALYSIS OF ACQUISITIONS HAVING
100 PERCENT OR GREATER COST GROWTH

Agency and project	Original estimate Date	Original estimate Amount (000 omitted)	Baseline Date	Baseline estimate Amount	Cost change due to: Quantity	Engineering	Support	Schedule	Economic	Estimating	Sundry	Current estimate Date	Current estimate Amount (000 omitted)
					(000 omitted)								
APPALACHIAN REGIONAL COMMISSION:													
Appalachian Development Highway	1965	$840,000	1965	$840,000	$462,000	$247,000	$-	$-	$500,000	$-	$ 41,000	1971	$2,090,000
ATOMIC ENERGY COMMISSION:													
Fast Flux Test Facility	9-66	87,500	9-66	87,500	-	78,200	-	23,700	20,700	182,100	27,800	12-73	420,000
New Weapons Production Capabilities, Various Locations	12-66	32,300	12-66	32,300	148,200	40,200	39,500	-	4,500	41,400	4,000	8-74	310,000
Total		119,800		119,800	148,200	118,400	39,500	23,700	25,200	223,500	31,800		730,100

ANALYSIS OF ACQUISITIONS HAVING
100 PERCENT OR GREATER COST GROWTH

Agency and project	Original estimate Date (note f)	Original estimate Amount (000 omitted)	Baseline estimate Date (note g)	Baseline estimate Amount	Cost change due to (000 omitted) Quantity	Engineering	Support	Schedule	Economic	Estimating	Sundry	Current estimate Date (note h)	Current estimate Amount (000 omitted)
DEPARTMENT OF THE ARMY, CORPS OF ENGINEERS:													
Flood Control:													
B. Everett Jordan Dam and Lake, N.C.	1963	[e]$ 25,462	1963	$25,462	$ -	$ 7,048	$ -	$ 57	$15,511	$25,416	$1,106	7-74	[e]$ 74,600
Beach Fork Lake, W. Va.	1962	11,000	1967	12,800	3,340	1,025	-	3,700	7,381	254	100	7-73	28,600
Big Darby Lake, Ohio	1938	5,214	1965	27,200	305	7,290	-	-	40,348	2,770	187	7-73	78,100
Caesar Creek Lake, Ohio	1938	3,595	1967	15,900	9,986	5,614	-	-	9,700	-	1,200	7-73	42,400
Carr Fork Lake, Ky.	1962	9,020	1965	11,200	18	18,297	-	-	9,185	-	-	7-73	38,700
Cooper Lake and Channels, Tex.	1955	[c]15,200	1961	[c]15,200	6,366	5,001	-	10,897	4,670	6,449	2,017	7-73	50,600
Dry Creek Lake, Calif.	1962	42,400	1967	51,000	421	22,942	-	1,806	30,982	1,115	4,734	7-73	113,000
East Lynn Lake, W.Va.	1937	[d]14,300	1965	14,300	5,485	4,455	-	770	4,479	1,196	315	7-73	31,000
Fire Island Inlet to Montauk Pt.N.Y	1960	19,700	1963	19,700	1,080	-	-	-	17,087	16,133	-	7-73	54,000
Gathright Lake, Va.	1946	[b]13,000	1967	16,300	-	20,000	-	1,000	10,200	500	1,800	7-73	49,800
Lake Ponchartrain and Vicinity, La.	1965	56,235	1967	65,784	17,882	33,891	-	15,760	63,021	5,130	1,532	7-73	203,000
Lake Shelbyville, Ill.	1958	[c]18,500	1961	[c]18,500	10,142	7,466	-	-	7,650	187	55	7-73	46,000
Lavon Lake Modifications and East Fork Channel Improvements, Tex.	1962	23,760	1967	27,300	1,350	19,566	-	-4,962	17,927	-1,681	-	7-73	59,500
Missouri River Levee System	1928	[d]60,600	1962	60,600	16	21,390	-	-	53,950	2,107	9,737	7-73	147,800
New Orleans to Venice Hurricane Protection, La.	1962	7,502	1964	7,580	26,648	12,594	-	975	18,542	8,321	240	7-73	74,900

ANALYSIS OF ACQUISITIONS HAVING
100 PERCENT OR GREATER COST GROWTH

Agency and project	Original estimate Date (note f)	Original estimate Amount (000 omitted)	Baseline estimate Date (note g)	Baseline estimate Amount	Cost change due to Quantity	Engineering	Support	Schedule	Economic	Estimating	Sundry	Current estimate Date (note h)	Current estimate Amount (000 omitted)
					(000 omitted)								
Flood Control: (cont'd)													
Papillion Creek, Neb.	1968	$26,800	1972	$38,000	$ 100	$19,585	$ -	$ -	$17,175	$ 3,000	$ 640	7-73	$78,500
Red River Lake, Ky.	1962	8,020	1967	10,700	1,193	1,813	-	-	9,886	-	4,008	7-73	27,600
Red River Levees and Bank Stabilization	1946	[c]10,000	1961	[c]10,000	-	18,300	-	236	4,492	960	12	7-73	34,000
River Rouge, Mich.	1962	8,659	1963	9,620	-	4,000	-	-	6,580	5,900	-	7-73	26,100
Sacramento River Bank Protection, Calif.	1960	14,240	1963	15,100	32,375	2,705	-	-	9,830	3,900	290	7-73	64,200
Saginaw River, Mich.	1958	[d]16,200	1963	16,200	4,866	-	-	-	17,500	6,900	300	7-73	45,766
San Antonio Channel Improvement, Tex.	1954	[b]15,870	1960	[a]15,870	-	4,705	-	-	10,365	1,694	2,466	7-73	35,100
Texas City & Vicinity, Tex.	1958	[b] 6,240	1962	6,670	14,172	53	-	-	11,231	13,174	-	7-73	45,300
Tombigbee River and Tributaries, Miss. and Ala.	1958	[e]19,311	1958	19,311	-	10,866	-	-	24,251	- 1,188	60	7-74	[e]53,300
Subtotal		450,828		534,297	135,745	248,606	-	30,239	421,943	102,237	30,799		1,499,866

ANALYSIS OF ACQUISITIONS HAVING
100 PERCENT OR GREATER COST GROWTH

Agency and project	Original estimate Date (note f)	Original estimate Amount (000 omitted)	Baseline estimate Date (note g)	Baseline estimate Amount	Cost change due to: Quantity	Engineering	Support	Schedule (000 omitted)	Economic	Estimating	Sundry	Current estimate Date (note h)	Current estimate Amount (000 omitted)
Mississippi River and Tributaries:													
Atchafalaya Basin, La.	1927	[c]$120,000	1961	[c]$120,000	$174,910	$228,425	$ -	$28,531	$85,592	$12,748	$10,794	7-73	$661,000
Lower Red River South Bank	1927	[b] 8,990	1960	[a] 8,990	8,124	-	-	2,030	6,098	1,158	-	7-73	26,400
Mississippi River Chache Basin	1949	[b,e]25,000	1960	25,000	137	9,068	-	4,394	13,592	9,562	6,947	7-73	[e]68,700
Mississippi River Channel Improvements	1927	[b]468,000	1960	[a]468,000	358,065	30,085	-	143,049	163,098	664,625	4,078	7-73	1,831,000
Mississippi River Levees	1927	[b]221,000	1960	[a]221,000	32,172	369,054	-	18,281	45,083	2,320	90	7-73	688,000
Mississippi River Tensas Basin, La.	1940	[c]31,700	1961	[c]31,700	57,120	23,785	-	8,800	47,072	17,173	850	7-73	186,500
Mississippi River Yazoo Basin	1935	[c]195,000	1961	[c]195,000	16,882	102,595	-	14,500	71,812	6,411	1,800	7-73	409,000
Mississippi River West Tennessee Tributaries	1947	[b] 8,400	1960	[a]8,400	12	4,272	-	-	6,988	7,096	1,979	7-73	28,747
Mississippi River St. Francis Basin	1935	[c]88,200	1961	[c]88,200	52,898	5,897	-	13,111	39,334	33,530	39	7-73	233,000
Subtotal		1,166,290		1,166,290	700,320	773,181	-	232,696	478,669	754,623	26,568		4,132,347

ANALYSIS OF ACQUISITIONS HAVING
100 PERCENT OR GREATER COST GROWTH

Agency and project	Original estimate Date (note f)	Original estimate Amount (000 omitted)	Baseline estimate Date (note g)	Baseline estimate Amount	Cost change due to: Quantity	Engineering	Support	Schedule	Economic	Estimating	Sundry	Current estimate Date (note h)	Current estimate Amount (000 omitted)
					(000 omitted)								
Multipurpose Projects Including Power:													
Bonneville Lock and Dam, Oreg.& Wash. (Modification for peaking)	1933	[i]$11,900	1970	$13,500	$ 6,100	$ 9,800	$ -	$ -	$ 6,800	$ 1,400	$ 200	7-73	$ 37,800
Carters Lake, Ga.	1945	[b] 38,000	1962	38,000	48,079	17,216	-	1,583	15,651	-15,036	507	7-73	106,000
Clarence Cannon Dam, Mo.	1962	[e] 63,300	1962	63,300	1,150	23,301	-	28,380	27,259	8,610	300	7-73	[e]152,300
DeGray Lake, Ark.	1950	[d] 32,500	1962	32,500	17,260	2,030	-	2,661	9,584	1,439	26	7-73	65,500
Harry S. Truman Dam and Reservoir, Mo.	1954	[b]102,000	1965	146,200	-	35,000	-	63,000	69,000	18,000	800	7-73	332,000
New Melones Lake, Calif.	1962	113,717	1966	122,000	100	19,490	-	1,770	60,115	48,865	4,660	7-73	257,000
Ozark Lock and Dam, Ark.	1946	[b] 36,300	1965	36,300	26,887	12,451	-	962	7,225	675	-	7-73	84,500
Snettisham Power Proj., Alaska	1962	41,634	1967	41,500	-	2,960	-	6,540	22,200	10,000	2,400	7-73	85,600
West Point Lake, Ga. and Ala.	1962	52,900	1965	53,000	10,982	3,250	-	10,183	13,820	20,580	280	7-73	112,095
Subtotal		492,251		546,300	110,558	125,498	-	115,079	231,654	94,533	9,173		1,232,795

ANALYSIS OF ACQUISITIONS HAVING
100 PERCENT OR GREATER COST GROWTH

Agency and project	Original estimate Date (note f)	Original estimate Amount (000 omitted)	Baseline estimate Date (note g)	Baseline estimate Amount	Cost change due to: Quantity	Engineering	Support	Schedule	Economic	Estimating	Sundry	Current estimate Date (note h)	Current estimate Amount (000 omitted)
				(000 omitted)									
Navigation:													
Jacksonville Harbor, Fla.	1965	$ 8,484	1968	$ 8,800	$ 900	$ -	$ -	$ -	$ 2,600	$ 11,000	$11,200	7-73	$ 34,500
Mississippi River Gulf Outlet, La.	1956	[b]101,000	1961	[c]105,000	83,455	7,911	-	7,390	67,665	4,371	208	7-73	276,000
Ouachita and Black Rivers, Ark. and La.	1960	43,550	1963	45,500	47,770	2,783	-	2,680	43,763	3,551	103	7-73	146,150
Wallisville Lake, Tex.	1962	9,162	1966	9,920	-	3,276	-	-	6,701	8,546	357	7-72	28,800
Weymouth-Fore and Town Rivers, Mass.	1965	12,500	1968	12,500	-	150	-	-	5,610	6,740	-	7-73	25,000
Subtotal		174,696		181,720	132,125	14,120	-	10,070	126,339	34,208	11,868		510,450
Total		2,284,065		2,424,607	1,078,748	1,161,405	-	388,084	1,258,605	985,601	78,408		7,375,458

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ANALYSIS OF ACQUISITIONS HAVING
100 PERCENT OR GREATER COST GROWTH

Agency and project	Original estimate Date	Original estimate Amount (000 omitted)	Baseline estimate Date	Baseline estimate Amount	Cost change due to: Quantity	Engineering	Support	Schedule	Economic	Estimating	Sundry	Current estimate Date	Current estimate Amount (000 omitted)
					(000 omitted)								
DEPARTMENT OF INTERIOR:													
Bureau of Reclamation:													
Fryingpan Arkansas Project, Colo.	1962	$170,000	1962	$170,000	$14,427	$66,517	$ -	$ -	$143,517	$ -	[j]$66,171	1974	$460,632
DEPARTMENT OF TRANSPORTATION													
Federal Aviation Administration:													
National Airspace Systems Stage A	10-65	212,000	10-65	212,000	350,700	-	-	-6,800	-	34,100	[k] 28,600	1974	618,600
Federal Highway Administration:													
Interstate Highway System	1958	[l]37,600,000	1958	37,600,000	5,547,000	17,463,000	-	-	n	9,230,000	[n]6,460,000	1972	[l]76,300,000
Urban Mass Transportation Administration:													
Morgantown Personal Rapid Transit System	5-71	28,300	5-71	28,300	20,500	-	-	800	8,800	5,900	-	3-73	64,300
Urban Rapid Rail Vehicles and Systems Program	4-72	11,029	4-72	11,029	6,400	[m] 500	-	-	-	7,900	500	7-74	26,329
Subtotal		39,329		39,329	26,900	500	-	800	8,800	13,800	500		90,629
Total		37,851,329		37,851,329	5,924,600	17,463,500	-	-6,000	8,800	9,277,900	6,489,100		77,009,229

ANALYSIS OF ACQUISITIONS HAVING
100 PERCENT OR GREATER COST GROWTH

Agency and project	Original estimate Date	Original estimate Amount (000 omitted)	Baseline estimate Date	Baseline estimate Amount	Cost change due to: Quantity	Engineering	Support	Schedule	Economic	Estimating	Sundry	Current estimate Date	Current estimate Amount (000 omitted)
				(000 omitted)									
GENERAL SERVICES ADMINISTRATION:													
Beltsville Consolidated Federal Law Enforcement Training Center	1-69	°$18,073	1-69	$18,073	$8,279	$20,879	$ -	$ -	$21,449	$ -	$5,715	p	$74,395
J. Edgar Hoover FBI Building	3-62	° 60,000	3-62	60,000	-	32,744	-	-	31,289	-	2,075	12-73	126,108
Philadelphia Federal Office Building	6-71	P 42,680	6-71	42,680	1,150	8,359	-	-	35,290	-	-	12-73	87,479
Total		120,753		120,753	9,429	61,982	-	-	88,028	-	7,790		287,982
NATIONAL RAILROAD PASSENGER CORP:													
Turbine Cars	11-73	35,000	11-73	35,000	35,000	-	-	-	-	-	-	3-74	70,000
GRAND TOTAL		$41,420,947		$41,561,489	$7,672,404	$19,118,804	$39,500	$405,784	$2,024,150	$10,487,001	$6,714,269		$88,023,401

[a]Initial detailed estimate was made before fiscal year 1960; therefore, 1960 estimate is used.

[b]Fiscal year 1960 estimate; initial date (fiscal year) of authorization is given.

[c]Authorization and initial detailed estimates were made before fiscal year 1960; fiscal year 1961 estimates were earliest ones available.

[d]Baseline estimate used since authorization amount not furnished.

[e]Cost breakdown on this project was made between the original estimate and the current estimate instead of a later baseline.

[f]Year of authorization; in most cases estimate was made 1 or 2 years before authorization.

[g]Fiscal year of baseline; in most cases the estimate was made in previous July.

[h]Fiscal year 1975 estimate.

[i]July 1965 estimate.

[j]Includes: $64,522,000 for costs of constructing recreation and fish and wildlife facilities and conserving scenery on project lands and $1,649,000 for costs of relocating roads to current standards not included in the $170 million cost estimate.

[k]Includes $32.7 million of cost increases not specifically defined by Federal Aviation Administration, and $4.1 million in decreases designated as program adjustments.

[l]Federal share is $33.9 billion and $68.26 billion, respectively.

[m]Urban Mass Transportation Administration considered "support" changes in this figure.

[n]Economic factor not separately broken out, included in sundry.

[o]Initial Prospectus Authorization.

[p]Prospectus pending at October 1974.

LIST OF MAJOR CIVIL ACQUISITIONS
SELECTED FOR GAO STUDIES

Agency and Fiscal Year	System
Atomic Energy Commission:	
1975	Fast Flux Test Facility
Corps of Engineers:	
1975	Harry S. Truman Dam and Reservoir
Department of Transportation:	
1973	Automated Radar Terminal System (ARTS III)
1974	Icebreakers
1975	Locomotives and Cars for the National Railroad Passenger Corporation (AMTRAK)
1975	Personal Rapid Transit System, Morgantown, W. Va.
1975	Icebreakers
National Aeronautics and Space Administration:	
1973	Applications Technology Satellite (ATS)
1973	Viking
1974	Space Shuttle
1975	Viking
1975	Space Shuttle
Tennessee Valley Authority:	
1975	Sequoyah Nuclear Power Plant

Chairman HUMPHREY. Congressman Brown, do you have anything?

Representative BROWN of Ohio. I would like to know if there is anything the Government has done in the last 2 years that hasn't had a cost overrun?

Mr. STAATS. Pardon me?

Representative BROWN of Ohio. I would like to know if there is anything the Government has done in the last 2 years that hasn't had a cost overrun?

Mr. STAATS. Strangely enough, we found one or two that haven't.

Representative BROWN of Ohio. Could you identify those?

Mr. STAATS. It is in our report.

Chairman HUMPHREY. Well, I want to defend the Government here. I don't think anybody can always be right about these figures. Did you ever have a garage door fixed or ever take your television down and have it fixed?

Mr. STAATS. There was a major cost overrun in this building we are in right now.

Let me say this, though. I think this is something that is not well understood as it should be in talking about cost overruns on any program, and this goes back to the point we were discussing earlier. We are trying to factor out wherever we can the element of the so-called inflation in cost growth. We prefer to use cost growth to overrun. It is not easy to do, because you can't just take the Consumer Price Index or an index of plant and equipment costs or raw materials. These are not necessarily good indicators of what happens to inflation for a particular program. It depends upon the program elements and the kind of labor that goes into that program and many other considerations. So that we do need, in all cases, to recognize that cost growths is made up not only of errors in judgment and change orders and modifications of programs, of mistakes. management and so on, but it is also made up of this big element of inflation.

Representative HAMILTON. Mr. Staats, in your response and Mr. Hughes' response, you just explained away the possibility that the Congress has been misled in any respect. Is it your judgment that we have not been misled in the figures that were given to us and that they were the best figures that were available at the time and there is no indication that these figures were cut when they were originally presented to us?

Mr. CARLONE. I certainly have no indication of this on the $699 million figure. On the initial estimate for the CRBR, it was recognized at that time that it was based on a preliminary design, and it was recognized that as the design became more finalized, as the design became more firm, that the costs would go up. As Mr. Hughes pointed out, a large portion of the $1.7 billion was due to inflation.

Representative HAMILTON. I know my time has expired, Mr. Chairman, but I must say, we are just playing games with figures here. The estimates that are given to Congress are almost meaningless in terms of total costs when you come down to the end.

Mr. STAATS. If you will bear with us, in the forthcoming report that we will be presenting shortly, we will trace this whole cost pattern from the beginning up to the present time.

Chairman HUMPHREY. Might I add that it will be interesting to find out how many times the Government asked for moderations of the programs. The Government is notorious for deciding in the midst of a project that it would like to change the doors, the plumbing, the heating, the roof, and goodness knows what else. I know two contractors out in our city, Mr. Staats, who have gone broke because the Government saw to it they had fixed price contracts and then kept changing things. It is sort of like your wife, when you are remodeling your house, saying, "Oh, but I wanted a nice picture window there" and that is after you've got it bricked in. So you've got to go to a contractor and he will say, "Well, that will cost you $1,000". That is where a lot of the cost overruns come from.

I am not trying to defend what I consider to be waste and inaccuracy, but on new projects there are always these constant changes. It just happens all the time.

Mr. STAATS. We make reports available to the Congress on military weapons systems, Senator, and in those we identify what we call change orders as an element.

Chairman HUMPHREY. Yes.

Mr. STAATS. Now, a change order may arise purely unilaterally from the Government side, where some new development makes it possible to incorporate an improvement into the system, but at an additional cost; or it may come from the contractor by mutual agreement between the contractor and the Government where modifications take place which do cause increased costs to the program either because of delay in the delivery of product or because it is more expensive to produce.

Representative BROWN of Ohio. Mr. Chairman, you just ruined my day, because this morning I put my wife on an airplane to Ohio and she is going to spend 2 days with the fellow who is building our house up there.

Chairman HUMPHREY. Yes; I have gone through the same thing.

Representative BROWN of Ohio. And I am more shaken by your experience with your house than I am with Mr. Staats' experience with the breeder reactor. But, I will persist with my duty here to ask you about these projects and pursue them.

The point that the chairman was raising in a way is the same as in your testimony, where you identified six areas which contribute an important element of technology to the breeder program: Reactor physics, fuels and materials, fuel recycle, safety, component development, and plant experience.

And I am curious to know what the cost overrun impact or the cost growth impacts were in these areas? What were the areas where the growth was highest, or did your accounting procedures permit you to separate them out into the six areas which you have identified here?

Mr. CARLONE. I have been reminded that these are new categories, which regroup previous program elements. There are no specific past figures on them, but we can look into it and supply it for the record.

Representative BROWN of Ohio. Well, is there any way to identify the increases with reference to the question the chairman posed: Whether or not some of these areas have been responsible for major parts of the increase because Congress has taken a new interest, for instance, in the question of safety; or because we have taken a new interest, perhaps, in the fuel sources of the reactors; or because the fuel sources have changed through the development of scientific research?

Mr. HUGHES. It seems to me, Mr. Brown, that ERDA people might be of more direct assistance than we in responding to your question. For example, we refer to the experience with the fast flux test facility. The original estimate of the cost there was $87.5 million.

Representative BROWN of Ohio. In your oral statement?

Mr. STAATS. Yes, in our testimony this morning.

Representative BROWN of Ohio. OK.

Mr. HUGHES. We have identified the escalation there, Mr. Brown. We aren't in a position to sort out the components of that, but as you can see, the change in estimates from $87.5 million to $512 million was pretty spectacular. We talked also about the experience with the Clinch River plant. We also referred earlier in our statement, to the sodium pump test facility, where the experience has shown the original cost estimate of $6.8 million will roughly double. And then came one of these change orders that the chairman referred to. It will permit, I gather, a new type of test to be conducted which will add $40 million to that figure.

Representative BROWN of Ohio. Well, really what I am asking is about the six areas that you identified as parts of the program. I have listed them already and I want to know where is the biggest problem here in terms of cost overrun, or is there a problem endemic in the whole field of advanced breeder reactors that applies to all of them?

Mr. HUGHES. We can't respond to your question, Mr. Brown. My guess is that the experience is pretty general. Cost overruns are chronic in Government and in life in general, partly because of inflation, but in part, I think, because projects which are proposed generally tend to be estimated on the low side by those who are proposing them. I think that is not necessarily a matter of bad faith.

Representative BROWN of Ohio. Let me ask you about the experience of other nations in this field. You make reference later in your testimony to the fact that the Russians and the French are making some progress in this field, and Japan and West Germany and the United Kingdom also are involved in such programs. What has been their experience? Have our overruns exceeded their experience in this field?

Mr. HUGHES. We don't know what their experience has been with overruns.

Mr. STAATS. The general impression that we have is that they have had less of a problem than we have had because they have been on a tighter time schedule. They put less money into environmental and safety features than we are trying to build into ours. Possibly they have had tighter program management than we have had. All three of these factors have been pointed out to me by some of the people in the National Academy of Sciences and others who have studied this. This enables them to do their work to date with less cost then we have had.

Representative BROWN of Ohio. What is the relationship of their reduced expenditures in environmental and safety features to our expenditures?

Mr. STAATS. I am not sure that we can answer that. Before you arrived, we committed ourselves to the chairman to see if we can get a detailed analysis of the European experience compared to our own.

Representative BROWN of Ohio. In trying to get that information, is there a problem of secrecy and that sort of thing?

Mr. STAATS. There may well be.

Representative BROWN of Ohio. Is there a problem of security for them?

Mr. STAATS. It is possible that that will present a problem, but we will just have to explore the matter.

Mr. HUGHES. I think not only national security considerations but also trade secrets, patent rights, commercial processes, and so on, are involved. I understand that there is a good deal of information exchange within the scientific community amongst all of these nations that are working on the breeder, but obviously there are constraints.

Representative BROWN of Ohio. Do you know if there is any consideration in our new organization of oil-consuming nations, which is concerned about alternative sources of energy, to try to stimulate further interactions between the nations in this research field so that there is a freer flow of information on such exotic energy sources as the fast breeder reactors and others?

Mr. STAATS. I don't think we are aware of any.

Representative BROWN of Ohio. It might be an interesting question to pursue when you consider the methods by which you are going to get this information. Is there any way in the costing methodology that we can anticipate overruns better than on the basis of past experience? Have you been able, Mr. Staats, as the result of our rather lengthy experience now with inflation, and with various inflation rates, to put together any rule of thumb or new guidelines for procurement?

Now, as I started to say, I am on the Government Operations Committee and we have come up with a couple of new pieces of procurement legislation which have helped in the more routine procurements, but because of the exotic nature of this science, and because of the rather separate nature of the Atomic Energy Commission and so forth, and the large size of the project and the fact that it is an experimental project, I guess many of those procurement rules are not applicable. Is that true?

I am asking too long a question here, but, first, is my presumption correct that for this we just don't have any groundrules?

Mr. STAATS. The Commission on Government Procurement, which reported last year and which I was a member of, and which Congressman Holifield was vice chairman of, as I recall, devoted more time to this issue than any other single issue that it had before it. In addition, the GAO has spent a great deal of effort in studying the management of individual weapons systems from the point of view of what we could learn about program management that would result in reducing costs. I guess you would have to say that rule No. 1 is that it is awfully difficult to generalize and make a statement which would cover all systems involved, but there are some things that I believe we can reasonably generalize about.

One is the need to do an adequate job on specifications on what it is we are trying to buy before we go so far as to commit ourselves on production. Now, that means that you've got to do better planning and in some cases you've got to do prototyping. We've got to do better testing before we make that production commitment. That is, I think, pretty good as a generalization.

Another good generalization is good program management; you know, giving them enough authority to go ahead and do the job and not changing managers every 2 or 3 years, which is what they were doing up until fairly recently. We got a new program manager and he had to start all over again. He had a different idea or approach——

Representative BROWN of Ohio. It is particularly true in experimental or exotic fields, isn't it?

Mr. STAATS. If it is new technology—for instance, with the C-5A, we went for something called total package procurement which involved a lot of unknowns. A lot of development had to take place. The Government walked away and let the contractor worry about things that really weren't too essential to the ultimate use of that aircraft.

But, I think we have learned a lot over the past 5 to 10 years, particularly on how to improve the management of the acquisition of our major systems.

Representative BROWN of Ohio. We have legislated some changes in the procurement of more routine items as the result of your Procurement Commission study. Is there legislation that should be addressed to procurement in the experimental areas and in things like the fast breeder reactor and things like health experimental programs, grants, and so forth? Should we be addressing ourselves to that?

Mr. STAATS. I would have to check. Of the 149 recommendations made by the Commission, I believe 47 of them, if I am not mistaken, did involve legislation. There have been a number of bills enacted since that Commission's report. Most importantly, to establish an Office of Federal Procurement Policy in the OMB, which our Commission is unanimous on, and which fortunately has gone through. A number of the other less important pieces of legislation have been enacted.

Representative BROWN of Ohio. They are either executive or administrative decisions, too, without congressional action?

Mr. STAATS. Yes; the executive branch has set up task forces to review each of these recommendations. Some of them have and could be put into effect administratively, but a number of others need legislation.

For example, Buy-American can be changed administratively. I don't think it is going to be changed unless Congress rewrites the law, though. We would be happy to furnish you either for the record or separately, as you wish, the status of the implementation of the Procurement Commission's recommendations. The GAO does put out a report from time to time to give Congress a progress report with respect to implementation. We have issued one fairly recently to the Congress on this.

Chairman HUMPHREY. Would you furnish us that report? It would be relevant to put this into this body of testimony.

Representative BROWN of Ohio. I think it would be helpful for the Senators and Members to have it too.

Chairman HUMPHREY. Yes; the individual Members.

Mr. STAATS. Yes, Mr. Chairman, we will furnish that report.

[The following report was subsequently supplied for the record:]

REPORT TO THE COMMITTEE ON GOVERNMENT OPERATIONS HOUSE OF REPRESENTATIVES

Executive Branch Action On Recommendations Of The Commission On Government Procurement

BY THE COMPTROLLER GENERAL OF THE UNITED STATES

PSAD-75-61

MARCH 17, 1975

COMPTROLLER GENERAL OF THE UNITED STATES
WASHINGTON, D.C. 20548

B-160725

The Honorable Jack Brooks, Chairman
Committee on Government Operations
House of Representatives

Dear Mr. Chairman:

In the spring of 1973, the executive branch set up a program to respond to the 149 recommendations of the Commission on Government Procurement. This is the fifth in the series of GAO reports replying to your Committee's request to monitor progress of the executive branch program.

We are sending copies of this report to the Senate Government Operations subcommittee having primary interest in Federal procurement matters; other congressional committees interested in procurement; Director of the Office of Management and Budget; Administrator of Federal Procurement Policy; Administrator of General Services; heads of the 14 lead agencies involved in the executive branch program; and to each member who served on the Commission on Government Procurement.

Sincerely yours,

Elmer B. Staats

Comptroller General
of the United States

CONTENTS

ABBREVIATIONS

ADPE	Automatic Data Processing Equipment
AEC	Atomic Energy Commission
ASPR	Armed Services Procurement Regulation
B&P	Bid and Proposal
CSC	Civil Service Commission
DCAS	Defense Contract Administration Services
DDR&E	Director of Defense Research and Engineering
DOD	Department of Defense
DOJ	Department of Justice
DOL	Department of Labor
DOT	Department of Transportation
DSARC	Defense Systems Acquisition Review Council
FMC	Federal Management Circular
FMN	Federal Management Notice
FPMR	Federal Property Management Regulation
FPR	Federal Procurement Regulation
GAO	General Accounting Office
GSA	General Services Administration
HEW	Department of Health, Education, and Welfare
IR&D	Independent Research and Development
NASA	National Aeronautics and Space Administration
NSF	National Science Foundation
NSF/OST	National Science Foundation, Office of Science and Technology
OASD	Office of Assistant Secretary of Defense
OFPP	Office of Federal Procurement Policy
OMB	Office of Management and Budget
SBA	Small Business Administration
TSARC	Transportation Systems Acquisition Review Council
USDA	U.S. Department of Agriculture

COMPTROLLER GENERAL'S REPORT TO THE COMMITTEE ON GOVERNMENT OPERATIONS HOUSE OF REPRESENTATIVES

EXECUTIVE BRANCH ACTION ON RECOMMENDATIONS OF THE COMMISSION ON GOVERNMENT PROCUREMENT

DIGEST

WHY THIS REVIEW WAS MADE

The Chairman of the House Government Operations Committee asked GAO to report periodically the actions being taken by the executive branch on the 149 recommendations of the Commission on Government Procurement to reform Federal procurement.

This is the fifth in this series of reports. (See p. 1.)

FINDINGS AND CONCLUSIONS

Although progress in establishing executive policy on Commission recommendations has been good, several more years will be required to put those adopted into effect. There are unresolved issues or problem areas in executive branch actions on about one-third of the Commission recommendations.

Executive branch program

The Office of Management and Budget, early in 1973, established the procedure for action on the Commission's recommendations. Action is coordinated throughout the executive branch by the General Services Administration in two phases.

First, an executive policy must be established on each Commission recommendation. This is decided at meetings of high-level procurement policy officials on the basis of an interagency task group report and comments from Federal agencies and industry. (See p. 15.)

Second, if a Commission recommendation is adopted, it is put into effect by an implementing action, such as

--a coordinated Armed Services/Federal procurement regulation;

--a Government-wide circular; or

--legislation. (See p. 15.)

Status of Commission recommendations

As of January 1 this year, executive policy had been established on 77 of the Commission recommendations. Proposed policy on most of the remaining 72 recommendations had progressed to higher executive branch levels. (See p. 16.)

The 77 recommendations with policy positions compares with 40 six months before. The executive branch has now adopted 64 (including 7 with some modification) and rejected 13. (See p. 20.)

Implementing actions have been completed on 7 of the adopted recommendations and have been started on 53 others. (See p. 20.)

The small number of actions completed to date and slippages in completion of others indicate that several more years will be needed to put Commission recommendations into effect. (See p. 21.)

Commission recommendations needing special management attention

There are 44 Commission recommendations in need of special management attention:

--4, where executive policy or its implementing action was found to be less than fully responsive.

--12, where responsiveness of executive policy could not be determined because of unresolved implementation issues.

--28, where resolution of significant problem areas is necessary before arriving at executive policy.

The executive branch is presently giving attention to some of these unresolved issues and problem areas. The reasons underlying the need for special management attention on the 44 recommendations are identified in table 7. (See. pp. 24-26.)

Schedules at the end of the report contain a short statement of each of the 149 Commission recommendations and show:

--Whether adopted, modified, or rejected.

--Type of implementation action taken or contemplated.

--History and current status of executive branch action.

--Those in need of special management attention and why.

General Services Administration staff analyses summarizing executive branch material and identifying key issues were of great assistance. (See p. 22.)

Congressional actions

In August 1974, Congress acted on the first recommendation of the Procurement Commission by establishing, through legislation, the Office of Federal Procurement Policy within the Office of Management and Budget. In December 1974, an administrator was confirmed by the Senate and his budget was approved. (See pp. 9-12.)

Under the law, the Administrator is to

--provide overall direction of Federal procurement policy,

--prescribe a Government-wide regulatory system,

--hold public meetings, and

--be responsive to the Congress.

He may not delegate his basic decisionmaking authority or become involved in day-to-day procurement activities or have his procurement reform role diluted by extraneous responsibilities. (See pp. 10 and 11.)

Functional divisions and duties of the Office have been developed. (See p. 14.)

Proposed policy positions on 41 Commission recommendations have been referred to the Office for final decision. (See pp. 18 and 19.)

The last Congress enacted into law 4 more Commission recommendations and had bills on 31 other recommendations pending before House and Senate committees. (See pp. 2-7.)

RECOMMENDATIONS

The Director, Office of Management

and Budget, should have the Administrator of Federal Procurement Policy:

--Establish priorities and milestones for those implementing actions lacking completion dates.

--Establish clear responsibility within the executive branch to followup implementing actions and assure conformity with policy positions and implementing guidelines agreed upon earlier.

--Make sure that appropriate action is taken on the 44 recommendations in need of special management attention.

--Develop a legislative program for coordination with appropriate congressional committees. (See pp. 22 and 23.)

MATTERS FOR CONSIDERATION BY THE COMMITTEE

Bills pending at the adjournment of the last Congress need to be reintroduced, and consideration needs to be given to introducing legislation on an additional 26 recommendations. (See pp. 3-6.)

The more crucial stage of the executive branch program--putting policy into effect--is still ahead. Maintaining the current momentum for Government-wide procurement reform depends on:

--Continued congressional initiative on introducing needed legislation. (See pp. 2-7.)

--Clearly established responsibility in both houses of the Congress for coordinated action on Government-wide procurement legislation. (See pp. 7 and 8.)

--Rapid achievement of full operational status and effective leadership by the Office of Federal Procurement Policy. (See pp. 12 and 13.)

--Assignment of authority and responsibility within the executive branch for followup and approval of implementing actions. (See pp. 20 and 21.)

CHAPTER 1

INTRODUCTION

The Commission on Government Procurement, created by the Congress, made 149 recommendations following a 2 1/2-year study of Federal Government procurement. As requested by the Chairman of the House Government Operations Committee early in 1973, GAO has been monitoring a program established by the executive branch to consider these recommendations. This is the fifth in the series of our reports.[1]

The report first outlines the status of implementing legislation introduced in the Congress on the recommendations; next, reviews the statutory responsibilities and operational status of the new Office of Federal Procurement Policy (OFPP), established by law in response to the Commission's first recommendation; and finally, summarizes progress, status, and responsiveness of executive branch actions on each of the 149 recommendations as of January 1, 1975.[2] These actions are discussed individually in supporting schedules. In the last chapter of the report, areas warranting special management attention are identified and recommendations are made to the Director, Office of Management and Budget.

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[1]B-160725, June 19 and September 19, 1973; January 31 and July 31, 1974.

[2]In a few instances, later information on important events is included.

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CHAPTER 2

STATUS OF CONGRESSIONAL LEGISLATION

The Commission identified more than 4,000 procurement-related statutes, many of which were outmoded, inconsistent, overlapping, or redundant. Two main thrusts of the Commission recommendations are to replace the existing statutory fragmentation with a modern, unified statutory framework and to establish a point of leadership in the executive branch that, among other things, would keep the statutory framework and related policies up to date.

The first Commission recommendation called for creation in the executive branch of an Office of Federal Procurement Policy. Next were a group of recommendations for establishing the new statutory framework within which OFPP would operate. These recommendations seek to modernize and consolidate the two basic procurement statutes--the Armed Services Procurement Act of 1947 and the Federal Property and Administrative Services Act of 1949--both enacted some 25 years ago to establish procurement methods and award procedures for the military and civilian agencies.

Various other Commission recommendations call for enactment of legislation; they are identified in table 1 along with their present status.

TABLE 1

STATUS OF LEGISLATION (note a)

Purpose	Commission recommendation (note b)	Bill or law number	Date introduced or enacted	Sponsored by	Committee of jurisdiction	Status
Create OFPP with requirements for Government-wide regulatory and data systems and private sector rulemaking participation	A-1, 10, 11 D-1	Public Law 93-400	Aug. 1974	Reps. Holifield, Horton Sens. Chiles, Roth	House and Senate Government Operations	Enacted into law; Administrator confirmed by Senate Dec. 1974.
Modernize and consolidate basic procurement statutes	A-2 through A-9; E-1, 4; G-21 through G-24; J-2	H.R. 9061	June 1973	Reps. Holifield, Horton	House Judiciary	No action.
Raise ceiling for use of simplified small purchase procedures from $2,500 to $10,000	A-7	Public Law 93-356	July 1974	Reps. Holifield, Horton Sens. Chiles, Roth	House and Senate Government Operations	Enacted into law.
Establish national policy of reliance on private sector for needed goods and services	A-22	-				Legislation not yet introduced.
Eliminate executive and congressional delays in making available requested procurement funds	A-27	Public Law 93-344	July 1974	Several Congressmen	House and Senate Government Operations	Measures to reduce congressional delays incorporated in Congressional Budget Reform Act.
Authorize negotiated sale of surplus elephantine tools	A-36	H.R. 14289	Apr. 1974	Rep. Corman	Armed Services	No action.
Raise threshold to $10,000 for application of socioeconomic requirements	A-44					Legislation not yet introduced
Provide uniform sanctions for socioeconomic requirement violations	A-46					Legislation not yet introduced.

TABLE 1

STATUS OF LEGISLATION (note a) (continued)

Purpose	Commission recommendation (note b)	Bill or law number	Date introduced or enacted	Sponsored by	Committee of jurisdiction	Status
Provide discretionary use of Federal Laboratory funds to support national research and development objectives	B-2					Legislation not yet introduced.
Eliminate research and development cost-sharing except where performers benefit	B-8					Legislation not yet introduced.
Provide uniform Government-wide treatment of independent research and development and bid and proposal costs as allowable overhead costs of doing business	B-10					Legislation not yet introduced.
Improve executive branch budgeting and programming and strengthen congressional control	C-2, 5	S. 1414	Mar. 1973	Sen. Chiles et. al.	Senate Government Operations	Reported out of Committee; partially incorporated in Congressional Budget Reform Act (Public Law (93-344).
Make Government wholesale supply systems competitive with private systems on a total economic cost basis	D-6					Legislation not yet introduced.
Authorize multiyear leasing of automated data processing equipment	D-13	S. 2785	Dec. 1973	Sens. Percy, Chiles	Senate Government Operations	Passed Senate Sept. 1974 and sent to House.

TABLE 1

STATUS OF LEGISLATION (note a)(Continued)

Purpose	Commission recommendation (note b)	Bill or law number	Date introduced or enacted	Sponsored by	Committee of jurisdiction	Status
Establish central agency management coordinator for Federal food-quality assurance programs	D-17					Legislation not yet introduced.
Clarify distinction between contract and grant-type assistance transactions and authorize study of policy guidance for Federal assistance programs	F-1, 2	S. 3514	May 1974	Sens. Chiles, Roth	Senate Government Operations	Passed Senate Oct. 1974 and sent to House.
		[c]H.R. 9060	June 1973	Reps. Holifield, Horton	House Government Operations	Committee held hearings in Nov. 1974 on both S. 3514 and H.R. 9060.
Establish integrated system of legal remedies for contract performance disputes	G-2 through G-12	H.R. 16423	Aug. 1974	Reps. Holifield, Horton	House Judiciary	No action.
		H.R. 9062	June 1973			
Establish regional small claims boards	G-4	S. 3610	June 1974	Sen. Hathaway	Senate Judiciary	No action. See G-2 through G-12 above.
Establish Government catastrophic insurance program to compensate victims and indemnify contractors under Government-connected programs	H-4, 5					Legislation not yet introduced.
Establish uniform Government-wide policies on patents, technical data, and copyrights, including authorization for agencies to acquire rights or interests therein and to settle infringement claims	I-2, I-4 through I-9, 11, I-13 through I-15					Legislation not yet introduced.

TABLE 1

STATUS OF LEGISLATION (note a) (Continued)

Purpose	Commission recommendation (note b)	Bill or law number	Date introduced or enacted	Sponsored by	Committee of jurisdiction	Status
Organize, consolidate, and codify procurement statutes as appropriate under U.S.C. 41, public contracts	J-1					Legislation not yet introduced.
Extend and expand Renegotiation Act to cover all Government contracts, raise jurisdictional amount, and clarify profit criteria used	J-3 through J-6					legislation not yet introduced.

[a] This table shows the status of legislation as of the expiration of the 93d Congress on December 20, 1974. The source for 26 recommendations requiring legislation that has not yet been introduced was the Commission report. (See ch. 7, vol. 4, "Legislative Action Recommendations".)

[b] See ch. 4 schedules for text of these recommendations.

[c] H.R. 9060 did not authorize feasibility study of policy guidance for Federal assistance programs.

As table 1 shows, five Commission recommendations were translated into law during the last Congress (A-1, A-7, A-10, A-11, and D-1). Another 31 recommendations were incorporated in bills introduced in the House or Senate. Four of the enacted recommendations cover creation of OFPP and three specific OFPP functions. (See ch. 3.) The fifth recommendation enacted into law raised the ceiling for simplified small purchase procedures from $2,500 to $10,000.

In 1973, House members introduced bill 9061 providing a new statutory framework to simplify and streamline the procurement process Government-wide; eliminate obsolete or unworkable statutory provisions; and remove inconsistencies between the two basic civilian and military procurement statutes. The House referred this bill to its Judiciary Committee, but that Committee was unable to act on it during the last session of the Congress. Upon reintroduction in the 94th Congress, the bill may be referred to the Committee on Government Operations or it may be considered by more than one committee in accordance with new House rules discussed later in this chapter. A Senate version of House bill 9061 is being developed for action early in the 94th Congress.

Because of inaction on House bill 9061 in the first session of the 93d Congress, one part of it dealing with small purchases was introduced as separate legislation and enacted by the Congress in July 1974 (Public Law 93-356). The executive branch implemented this law by issuing temporary regulations 1 month later. For procurements not exceeding $10,000, the law permits the use of short forms, simplified competitive procedures, and reduction of time consuming administrative work.

LEGISLATIVE JURISDICTION OVER PROCUREMENT MATTERS

Traditionally, legislative jurisdiction over procurement matters in the House and Senate has been split between the Government Operations and Armed Services Committees. But, in July 1973 the Senate established an Ad Hoc Subcommittee on Federal Procurement within its Government Operations Committee. The Subcommittee served as a coordinating point for Senate procurement matters during the 93d Congress; it developed and expedited several pieces of legislation; and it held joint hearings with other committees in areas of mutual interest.

In the 94th Congress, the Subcommittee has been made permanent with full subcommittee status and has been redesignated as the Subcommittee on Federal Spending Practices, Efficiency and Open Government. It will have consolidated jurisdiction over Federal spending practices, and the efficiency and economy of such practices in Federal agencies and programs. The Subcommittee will be particularly concerned with spending practices relating to Federal procurement, with laws, regulations, and procedures governing Federal contracts, grants, transfer payments, and with activities of the new OFPP.

In October 1974 the House resolved to reform the structure, jurisdiction, and procedures of its committees. The resolution[1] amended jurisdiction of the standing committees. For example, it specifically assigned to the Committee on Government Operations jurisdiction over all bills, resolutions, and other matters relating to "the overall economy and efficiency of Government operations and activities, including Federal procurement." The amendment gives to the Committee on Government Operations legislative jurisdiction over procurement matters which have Government-wide impact or involve more than one agency. The Speaker can now refer a bill to one or more committees or can split a bill and refer appropriate parts to committees having jurisdiction. In previous reports in this series, the Comptroller General has suggested:

> "The House Committee on Government Operations may wish to consider establishing a separate subcommittee or designating an existing subcommittee as a focal point for procurement matters to deal with modernizing and consolidating procurement statutes and with other procurement issues in coordination with interested committees."

In view of the considerable procurement legislation that will probably come before this Congress and in view of the continuing need for legislative and oversight hearings, we believe that such a subcommittee will help to coordinate shaping of procurement policy in the Congress and expedite action on needed Government-wide legislation.

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[1] H. Res. 988, Rept. 93-916, Pt. II, 93d Cong., 2d sess.

CHAPTER 3

OFFICE OF FEDERAL PROCUREMENT POLICY

As noted in previous reports in this series, the Commission found a vacuum in executive branch policy leadership which, over the years, allowed a maze of complex, sometimes contradictory, and often overlapping procurement statutes and regulations to evolve, many of which were long out of date. The Commission recommended a small professionally oriented Office of Federal Procurement Policy, responsive to the Congress, to be established by law.

In August 1974 the President signed Public Law 93-400, establishing the OFPP within the Office of Management and Budget. The law requires that OFPP be headed by an Administrator for Federal Procurement Policy appointed by the President with the advice and consent of the Senate. The legislative background and hearings on this important legislation are summarized in previous GAO progress reports and elsewhere.[1]

In its February 1974 report on the OFPP legislation, the Senate Government Operations Committee observed:[2]

> "This legislation is only the initial effort * * * to update and restructure the procurement process of the Federal Government to correct the abuses of the past, and to provide a system tailored to the demands of the future. It is but the first step, but it is the step that will set the pace for the future. It is the step that will demonstrate the determination of Congress to provide the legislative leadership and mandate necessary to bring about fundamental reforms in Federal procurement. It is an action by which Congress

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[1]For a more complete legislative history, see Herbert Roback and Charles Goodwin, "Office of Federal Procurement Policy: The Legislative Background," National Contract Management Journal, vol. 8, No. 2, Fall 1974.

[2]S. Rept. 93-692, 93d Cong., 2d sess., Feb. 26, 1974, p. 12.

can demonstrate to the public that it is concerned with fiscal responsibility in procurement and the restoration of public credibility in the ability of the Federal Government to make procurements in an efficient, effective and economical manner."

STATUTORY RESPONSIBILITIES

OFPP legislation specifies that the Administrator is to provide overall direction of Federal procurement policy and, with due regard to executive agency program activities, to prescribe policies and regulations for procuring goods and services. It further specifies that the Administrator may delegate to his staff, and to other agencies, any of his authority, functions, or powers, with one exception: the Administrator may not delegate his basic decisionmaking authority to set procurement policy and to prescribe regulations to carry out that policy. The legislation also requires him to open to the public certain formal, scheduled OFPP meetings concerning the establishment of procurement policies and regulations and to give a 10-day public notice of such meetings. The Administrator's functions include:

1. Establishing a system of coordinated and, to the extent feasible, uniform procurement regulations for the executive agencies.

2. Establishing criteria and procedures for an effective and timely method of soliciting viewpoints of interested parties in developing procurement policies, regulations, procedures and forms.

3. Monitoring and revising policies, regulations, procedures, and forms relating to Federal Government reliance on the private sector for needed property and services.

4. Promoting and conducting research in procurement policies, regulations, procedures, and forms.

5. Establishing a system for collecting, developing, and disseminating procurement data useful to the Congress, executive branch, and private sector.

6. Recommending and promoting Civil Service Commission and executive agency programs for recruiting, training, career development, and performance evaluation of procurement personnel.

Although the Administrator's authority is presently limited to procurements payable from appropriated funds, the legislation requires him to study procurements made with nonappropriated funds and to recommend to the President and the Congress useful administrative or statutory changes.

When the Congress assigned to OFPP responsibility for Government-wide procurement policy, it made clear that OFPP was not to become involved in day to day agency procurement activities. House and Senate reports further clarify that the Administrator's functions are not limited to those specified in the legislation but are to include other procurement-related functions necessary to accomplish legislative objectives.[1]

To insure that OFPP's procurement-reform role would not be diluted, the House and Senate conference substitute bill that was enacted into law included specific language: "except as otherwise provided by law, no duties, functions, or responsibilities, other than those expressly assigned by the Act, shall be assigned, delegated, or transferred to the Administrator." The conference report[2] makes it clear that this language was added to insure that the OFPP would not have its procurement-reform role diluted. The conferees did not wish to have the Administrator burdened with extraneous responsibilities or to have his basic functions transferred elsewhere.

The legislation also requires the Administrator to keep the Congress, and its committees, fully and currently informed of the major OFPP activities. He is to submit an annual report, and other reports as necessary, to the President of the Senate and the Speaker of the House, with appropriate legislative recommendations. The conference report states that, although the OFPP, as a component of OMB, will be subject to direction by the OMB Director, The Administrator will be held directly accountable by the Congress for effective performance of his statutory duties and responsibilities.

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[1]For examples, see H. Rept. 93-1176, pp. 4, 7, 9 and 25, and S. Rept. 93-692, pp. 16, 18 and 19.
[2]H. Rept. 93-1268, p. 11.

ORGANIZATIONAL/OPERATIONAL STATUS

In September 1974 OMB submitted a supplemental budget request for $660,000 to operate OFPP during the remainder of this fiscal year. The request included salaries of an Administrator, a professional staff of 14, and an administrative staff of 10. In December 1974 the Congress approved this budget request and appropriated the requested funds.[1] The Congress included language in OFPP legislation to assure that appropriated funds will be used only for OFPP activities and will not be mingled with appropriations for other OMB activities.

The former Assistant to the Director of OMB for Procurement Policy was nominated by the President as administrator and confirmed by the Senate on December 19, 1974.[2] At the confirmation hearing the Senate Committee explored:[3]

--Expected performance of the OFPP, including the need to exert strong, positive leadership.

--Scope of authority, including responsibility for procurement-related matters.

--Type and mix of people to be hired for key posts; the Administrator agreed to consult with the committee on selections.

--Need for open public meetings on important OFPP policy decisions.

--Responsiveness of the Office to the Congress.

--Progress on Commission recommendations in areas of (1) Government-wide regulatory system, (2) Federal Government reliance on the private sector and (3) acquisition of major systems.

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[1]Public Law 93-554.

[2]Congressional Record, Dec. 19, 1974, Pt. 1, p. D1414.

[3]Hearing before the Committee on Government Operations, U.S. Senate, 93d Cong., 2d sess., "Nomination of Hugh E. Witt to be Administrator of the Office of Federal Procurement Policy," Dec. 19, 1974.

OFPP is to be organized along functional lines to correspond to six key procurement areas. Chart 1 shows the contemplated functions and a number of illustrative assignments planned for each. Present staffing consists of four positions.

SUPPORTING ROLES OF EXECUTIVE AGENCIES

OFPP is currently studying the key supporting roles and relationships of executive agencies in supplementing OFPP's new statutory responsibilities. Discussions between OFPP and General Services Administration (GSA), for example, are underway; but no definite GSA role has been established. At his confirmation hearing, the Administrator testified that GSA's supporting role in directing and coordinating interagency task group responses to the Commission's 149 recommendations would remain unchanged for the time being. GSA's role is described in the next chapter.

CHART 1

PLANNED OFPP FUNCTIONAL DIVISIONS AND DUTIES

EXECUTIVE DIRECTION AND ADMINISTRATION

ADMINISTRATOR
DEPUTY ADMINISTRATOR

Systems Acquisition and Research and Development (R&D) (Assistant Administrator)

Establishing and coordinating policies for

(a) Major system acquisitions, including

1. requirements,
2. solicitation and source selection, and
3. competition

(b) R&D contracting, including

1. process for unsolicited R&D proposals, and
2. cost recovery and cost-sharing provisions.

Procurement Regulations (Assistant Administrator)

Establishing coordinated system of consistent and uniform procurement policies, regulations, procedures and forms for all Federal agencies, including establishment of:

(a) Policies for

1. procurement matters involving grants and Federal assistance programs,
2. soliciting and considering views of private business sector, Government agencies, and the public on major procurement matters, and
3. developing procurement data system on an agencywide basis responsive to needs of executive branch, industry, and the Congress.

(b) Systematic method for agencywide uniform implementation of procurement-related laws and executive orders.

(c) Regulations and procedures for construction and architect-engineering contracts.

Logistics, Communications and Government Reliance on Private Enterprise (Assistant Administrator)

Development of coordinated uniform policies and practices concerning

1. Government-owned resources versus contracting with private sector (OMB Circular A-76),
2. Federal contract specifications
3. automatic data processing,
4. transportation and communications, and
5. professional and personnel services contracts.

Contract Administration and Socio-economic Procurement Policies (Assistant Administrator)

Establishment of coordinated system of uniform policies and procedures for:

(a) Contract placement, execution, management, and audit, including such specific areas as

1. formal advertised and negotiated contracting,
2. contractor cost allowability, overhead, and profit,
3. contractor management systems, and
4. termination and cancellation of contracts.

(b) Implementation through such socioeconomic programs as

1. small business and labor-surplus contracting,
2. equal employment and other labor relations programs on employment of minorities, and
3. environmental protection.

Contract Law (Assistant Administrator)

Establishment of coordinated policies and procedures, including

1. Federal contract aspects of patents, data and copyrights,
2. procurement matters before Renegotiation Board and other Federal tribunals,
3. contract litigation in the Federal judicial system, and administrative boards,
4. protests of contract awards to the Comptroller General, and
5. disbarment and suspension practices.

Procurement Career Development and Training (Assistant Administrator)

Development and design of responsive program for Federal personnel assigned in procurement, including

1. interaction of procurement personnel with personnel of other related disciplines,
2. effective recruitment and retention of personnel,
3. grade level structuring, rotation, tenure, and promotion,
4. career development and training, and
5. initial development of coordinated effort to establish a Federal Procurement Institute wholly responsive to procurement research and training needs for career managers in procurement.

CHAPTER 4

EXECUTIVE BRANCH PROGRESS, STATUS, RESPONSIVENESS

About 2 years ago, OMB formulated an executive branch program for a coordinated response to the 149 recommendations of the Commission on Government Procurement. Our previous reports have described in detail the various steps in the program leading to establishing executive branch policy positions on the recommendations and processing implementing actions.

In brief, a policy position on a recommendation normally is first developed by an assigned interagency task group headed by a lead agency The position is then submitted to the GSA Office of Procurement Management for review and coordination with affected agencies and the private sector. An interagency policy group, consisting of top officials from the major procuring agencies and OFPP, meets regularly with GSA to decide upon ultimate policy positions and guidelines for the next step--implementation. Major policy or controversial matters, including those requiring legislative action, are referred to OFPP for final disposition.

When a final executive branch policy position is established, implementation action is initiated by developing a legislative proposal, an executive branch circular, or a regulation. A draft is coordinated with affected agencies and, if appropriate, with the private sector to arrive at a final version of the document.

The extent to which executive branch policy positions have been established on the 149 Commission recommendations compared with 6 months ago, is shown in table 2.

TABLE 2

STATUS OF EXECUTIVE BRANCH POLICY POSITIONS

	Number of recommendations At July 1, 1974	At Jan. 1, 1975
Positions in process lead agency task group level (see table 3)	26	12
Positions in process at executive branch level (see table 4)	83	60
Positions established (see table 6 for status of implementation)	40	77
	149	149

As shown, executive branch policy positions have been established on 77, or about 52 percent, of the recommendations, and another 60, or about 40 percent, are in process at top levels in the executive branch. Schedules at the end of this chapter show the current status of each response to the 149 recommendations as of January 1, 1975.

POSITIONS IN PROCESS AT TASK GROUP LEVEL

A few interagency task groups have not yet submitted their reports. Table 3 lists the 12 specific Commission recommendations lacking task group reports, lead agencies assigned to-them, and current target completion dates for these reports.

TABLE 3

IN PROCESS AT TASK GROUP LEVEL

No.	Recommendation	Lead agency assigned	Current target date
A-22, A-23, A-24, A-25, and A-26	Implement Government policy of reliance on private enterprise	OMB	None
A-35	Stimulate contractor acquisition of production facilities	DOD	Feb. 1975
A-41	Separate Defense Contract Administrative Services from Defense Supply Agency	DOD	Feb. 1975
A-44	Raise threshold to $10,000 for socioeconomic programs	DOL	Feb. 1975
A-46	Establish uniform debarment treatment and broader sanctions for socioeconomic violations	DOL	Feb. 1975
H-4 and H-5	Compensate catastrophic accident victims and indemnify contractors for uninsurable liability	AEC	Mar. 1975
J-1	Recodify procurement statutes	DOJ	Mar. 1975

As shown, practically all remaining task group reports are due in early 1975. Schedules at the conclusion of this chapter highlight the current situation on recommendations A-22 through A-26 on which no task group report is planned.

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POSITIONS IN PROCESS AT EXECUTIVE BRANCH LEVEL

There are now in process at higher executive branch levels task group positions on 60 recommendations as shown in table 4.

TABLE 4

IN PROCESS AT EXECUTIVE BRANCH LEVEL

	Number of recommendations
Positions in GSA Office of Procurement Management for review	1
Positions out for agency/private sector comment or having comments under review	18
Positions referred to OFPP for final decision	41
	60

Virtually all of the interagency task group reports at the executive branch level are out for agency and/or private sector comment, or such comments are under consideration either in GSA or in OFPP. Schedules at the end of this chapter show:

--Commission recommendations in each category listed in table 4.

--Interagency task group position on each recommendation.

--Significant agency comments or dissents on the task group positions.

--Positions referred to OFPP with the reasons why.

--Areas needing special management attention.

Positions referred to OFPP for decision usually involve major policy matters or important agency dissents. Some referrals were made more than 6 months ago to OMB, before OFPP was established. The following table shows the month of each referral awaiting decision.

TABLE 5. REFERRALS TO OFPP AWAITING DECISION

				1974				1975
Recommendations	*June or earlier*	*July*	*Aug.*	*Sept.*	*Oct.*	*Nov.*	*Dec.*	*Jan.*
A-12 to A-17, A-19, A-20 personnel policies	•							
A-30, A-31 profit guidelines								•
A-48 mandatory subcontracting	•							
B-1 to B-4 Federal R&D policy	•							
C-1 to C-12 acquisition of major systems								•
D-6 acquisition of commercial products						•		
D-16, D-17 food acquisition policy				•				
G-3, G-7, G-8 contract performance dispute remedies								•
G-21 to G-24 extension of Public Law 85-804			•					
J-3 to J-6 Renegotiation Act	•							

OFPP told us that some referrals, such as those on procurement personnel policies, involve Commission recommendations which are related to newly created OFPP functions. It was considered important for OFPP to achieve operational status before acting on these recommendations. OFPP said that executive branch proposals on the remaining referrals will require more time to resolve.

POSITIONS ESTABLISHED AND
STATUS OF IMPLEMENTING ACTIONS

Policy positions have been officially established on 77 recommendations, of which the executive branch has adopted 57, modified 7, and rejected 13. The schedules at the end of this chapter identify each of these 77 recommendations and explain why some have been modified or rejected.[1] Most of the rejected recommendations fall into two areas: three which would authorize grantees to procure from Federal sources of supply and six which would provide alternate or expanded legal remedies for contract performance disputes. As shown in the later discussions of the individual recommendations, the rejected recommendations generally concern judgmental matters on which opinions may reasonably differ as to appropriate Government policy.

Although establishment of policy positions is an important first step, little can be accomplished until the policy position is placed into effect. Table 6 shows the current status of implementing actions on those recommendations either adopted or accepted in modified form.

TABLE 6

STATUS OF IMPLEMENTING ACTIONS

	Number of recommendations
Implementing actions not begun	4
Implementing actions initiated but not completed	53
Implementing actions completed	7
	64

Schedules at the end of this chapter identify (1) whether the implementing action used or planned is legislation, Government-wide circular, or coordinated Federal/Armed Services procurement regulation and (2) whether a completion date has been set for the action.

[1]The rejected recommendations are A-32, B-9, D-8, D-9 D-10, G-2, G-4, G-6, G-9, G-10, G-12,I-4, and I-8.

In previous reports we recommended that the executive branch establish priorities and target dates for completing implementing actions and a legislative program. The OMB Director advised that his Office and GSA were working closely with the interagency policy group to expedite the review process generally and to identify recommendations for priority handling on a case by case basis. He also concurred with the need to coordinate a legislative program with congressional committees; he did not specify, however, when such a program would be established or by whom.

In our current review, we noted progress in establishing completion dates. We also noted 3- to 9-month slippages on some existing dates and 12 implementing actions lacking completion dates. Overall experience to date and the small number of completed actions indicate that at least several more years will be needed to put executive branch policy positions into effect.

In our July report, we recommended also that provision be made for evaluating and approving the basic implementing documents. The OMB Director agreed that this was necessary to insure that the Commission's intent and purpose was reflected in the ultimate action taken. However, he believed this should be done only for key recommendations as OFPP approval of every action would be unnecessarily delaying. In our current review, we noted that GSA has assumed on its own, followup responsibility in selected instances. It had not as yet been delegated authority and responsibility for taking such followup actions, however. If OFPP reviews are to be confined to only some of the implementing actions, we believe OFPP should clearly fix authority and responsibility for review of the others.

COMMISSION RECOMMENDATIONS NEEDING SPECIAL MANAGEMENT ATTENTION

We examined into the responsiveness of executive branch actions on the 77 recommendations for which policy positions had been established at January 1, 1975. We found 16 recommendations in need of special management attention:

--4, where executive policy positions or implementing actions were found to be less than fully responsive; and

--12, where responsiveness could not be determined because of unresolved implementation issues.

The criteria used in making our examination were not based on acceptance or rejection of a Commission recommendation, but rather on

--Clarity of executive branch position in either accepting, modifying, or rejecting the Commission recommendation.

--Accuracy of supporting material, including interpretation of recommendation and underlying data.

--Completeness and objectivity of discussion of the issues.

--Logic of rationale supporting executive branch position.

--Adequacy of proposed implementation to accomplish objective of the recommendation.

Our evaluations were greatly facilitated by the use of GSA staff analyses which objectively summarized task group reports and official agency comments and identified issues requiring resolution at higher executive branch levels.

We also examined executive branch progress on the remaining 72 Commission recommendations. As noted earlier, agency policy proposals on most of these recommendations have reached the GSA-OFPP level. We found 28 of these recommendations also in need of management attention because of significant problem areas that must be resolved in arriving at policy positions. In some instances OFPP and GSA were aware of the problem areas and were giving them attention.

Table 7 identifies all 44 recommendations in need of special management attention as well as the underlying reasons. These reasons are explained in the discussions of the individual recommendations that follow the table.

RECOMMENDATIONS TO THE DIRECTOR, OMB

We recommend that the Director, OMB, have the Administrator of Federal Procurement Policy:

--Establish priorities and milestones for those implementing actions lacking completion dates.

--Establish clear responsibility within the executive branch to followup implementing actions and assure conformity with policy positions and implementing guidelines agreed upon earlier.

--Make sure that appropriate action is taken on the 44 recommendations in need of special management attention.

--Develop a legislative program for coordination with appropriate congressional committees.

TABLE 7. RECOMMENDATIONS WARRANTING SPECIAL MANAGEMENT ATTENTION

Recommendation	*Underlying Reason*					
	Evaluation category (see legend)	*Further analysis needed*	*Interpretation of recommendation questionable*	*Complexity of implementation*	*Rationale for decision questionable*	*More expeditious implementation indicated*
A-10, single Government-wide coordinated system of procurement regulations	X					●
A-11, criteria for public participation in rulemaking	X					●
A-18, matching grade levels to procurement responsibilities and professionalism required	IX			●		
A-22 to A-26, implementing policy of reliance on private enterprise	IX			●		
A-27, timely financing of procurement	PR				●	
A-30, A-31, Government-wide guidelines for profit negotiations	IX			●		
A-36, negotiated sale of surplus heavy machine tools	PR				●	
A-47, new standards for measuring small business participation	IX			●		
A-49, program to enhance small business participation	NR	●				
B-7, restraints on unsolicited proposals	X	●				

PR - position partially responsive
NR - position nonresponsive
X - position established, evaluation deferred in view of proposed implementation
IX - position not established

TABLE 7 (Cont'd)

Recommendation	Underlying Reason					
	Evaluation category (see legend)	*Further analysis needed*	*Interpretation of recommendation questionable*	*Complexity of implementation*	*Rationale for decision questionable*	*More expeditious implementation indicated*
B-8, cost sharing	IX	●				
B-10, allowability of independent R&D and bid and proposal expenses	IX	●				
C-3, C-4, exploring alternative systems	IX	●				
C-11, C-12, system implementation	IX		●			
D-6, centralized versus direct procurement of commercial products	IX	●				
D-7, direct procurement overseas of U.S.—made commercial products	NR				●	
D-12, ADPE preplanning requirements delegation policy	IX	●				
D-14, ADPE proposal evaluation benchmarks	X					●
D-16, D-17, food acquisition policy	IX	●				
D-18, use of commercial methods for agency procurement of utilities	X		●			
D-19, innovative transportation procurement techniques	X	●				

NR - position nonresponsive
X - position established, evaluation deferred in view of proposed implementation
IX - position not established

TABLE 7 (Cont'd)

Recommendation	*Underlying Reason*					
	Evaluation category (see legend)	*Further analysis needed*	*Interpretation of recommendation questionable*	*Complexity of implementation*	*Rationale for decision questionable*	*More expeditious implementation indicated*
E-1, E-2, E-3, competitive procurement of architect-engineer services	IX	●				
E-4, repeal statutory architect-engineer fee limitation	X	●				
F-2, OFPP feasibility study of assistance program guidance	X					●
G-21, G-22, G-23, G-24, extension of Public Law 85-804	IX	●				
H-3, limit third-party (transferee) damage claims arising from Government property defects	X	●				
I-13, remedy for Government misuse of data	IX	●				
I-14, I-15, I-16, Government-wide policy for acquisition and use of copyrights	X	●				
J-6, Renegotiation Board profit criteria	IX	●				

X - position established, evaluation deferred in view of proposed implementation
IX - position not established

EXECUTIVE BRANCH POSITIONS AND IMPLEMENTING ACTIONS ON COMMISSION RECOMMENDATIONS AS OF JANUARY 1, 1975

Recommendation (GAO prepared these short-form statements of Commission recommendations. See indicated pages of Commission report for full texts)	Executive Branch Position in Process: Inter-agency task group led by	(Target) or actual date of task group report	Agency/industry comments due or under review	Date referred to OFPP for decision	Executive Branch Position Established: (Target) or actual date	Recommendation adopted, modified, or rejected	Implementation Phase, Legislation If Applicable: Bill or law	Date introduced or enacted
PART A--GENERAL PROCUREMENT CONSIDERATIONS:								
Establishment of OFPP:								
1. Establish by law a central OFPP to provide executive direction and coordination and to be responsive to the Congress (p. 9)	OMB	no submission			July 1974	Adopted	P.L. 93-400	Aug. 1974
Statutory framework:								
2. Consolidate existing legislation to provide a common statutory basis for establishing fundamental procurement policies and procedures applicable to all executive agencies (p. 15)	DOD	Nov. 1973			Dec. 1974	Adopted	H.R. 9061	June 1973
3. Authorize competitive negotiation as an acceptable aternative to formal advertising, but require documented reasons for its use in procurements over $10,000 (p. 20)	DOD	Nov. 1973			Dec. 1974	Adopted	H.R. 9061	June 1973
4. Extend competitive negotiated pro curement provisions to all agencies, provide for competitive rather than maximum number of solicitations, facilitate use of clarifying discussions, and require evaluation criteria in solicitations if basis of expected award is other than lowest cost (p. 22)	DOD	Nov. 1973			Dec. 1974	Adopted	H.R. 9061	June 1973
5. Require debriefings when requested by unsuccessful proposer in negotiated procurement (p. 25)	DOD	Nov. 1973			Dec. 1974	Adopted	H.R. 9061	June 1973
6. Authorize sole-source procurement when competitive procedures cannot be used, but require appropriate documentation for procurements over $10,000 and agency approval at higher administrative levels (p. 26)	DOD	Nov. 1973			Dec. 1974	Adopted	H.R. 9061	June 1973
7. Raise $2,500 ceiling for use of simplified purchase procedures to $10,000; OFPP reexamine at least every 3 years (p. 26)	DOD	Nov. 1973			Feb. 1974	Adopted	P.L. 93-356	July 1974

Implementation Phase			GAO Comments on Responsiveness of Executive Branch Actions
Executive Branch Action			Legend
Type	(Target) or actual comple-tion date		[R] Position fully responsive [I] Position not yet established Special Management Attention Needed [PR] Position partially responsive [NR] Position nonresponsive [X] Position established, evaluation deferred in view of proposed implementation [IX] Position not yet established
See ch. 3		[R]	Legislation introduced in the House and Senate in mid-1973 to create an OFPP. In lieu of having a task group report, OMB submitted its position at congressional hearings. In 1973 OMB urged deferral of legislation pending results of executive branch action to strengthen procurement policy leadership. In May 1974 it began working with the Congress on final draft of legislation. On August 30, 1974, the President signed the law creating OFPP. Progress in implementing this law is discussed in chapter 3.
		[R]	H.R. 9061, introduced during the last session of the Congress, provides for modernizing and unifying procurement statutes and for implementing recommendations A-2 thru A-9. On the basis of a task group report on these recommendations and agency comments on H.R. 9061, GSA has refined the bill's language to reflect an executive branch position. The revised bill was reviewed by OFPP and was sent in December 1974 to the House Judiciary Committee, together with rationale for the changes. GSA has published a notice in the Federal Register announcing acceptance of the recommendations. The executive branch has also endorsed provisions in the bill for competitive negotiation of architect-engineer services. (See E-1).
		[R]	See A-2 comments
		[R]	See A-2 comments
		[R]	See A-2 comments
		[R]	See A-2 comments
FPR/ ASPR	Aug. 1974	[R]	Executive branch submitted legislation on this recommendation in April 1974. Bills introduced in the Senate and the House were enacted the following July. The executive branch issued temporary regulations in August 1974 implementing this law.

EXECUTIVE BRANCH POSITIONS AND IMPLEMENTING ACTIONS ON COMMISSION RECOMMENDATIONS AS OF JANUARY 1, 1975

Recommendation (GAO prepared these short-form statements of Commission recommendations. See indicated pages of Commission report for full texts)	Executive Branch Position in Process: Inter-agency task group led by	(Target) or actual date of task group report	Agency/industry comments due or under review	Date referred to OFPP for decision	Executive Branch Position Established: (Target) or actual date	Recommendation adopted, modified, or rejected	Implementation Phase — Legislation If Applicable: Bill or law	Date introduced or enacted
PART A--GENERAL PROCUREMENT CONSIDERATIONS: (continued)								
8. Authorize use of multiyear contracts with annual appropriations for clearly specified, firm requirements (p. 27)	DOD	Nov. 1973			Dec. 1974	Adopted	H.R. 9061	June 1973
9. Repeal contractor's subcontract notification requirement (p. 28)	DOD	Nov. 1973			Dec. 1974	Adopted	H.R. 9061	June 1973
Regulatory framework:								
10. Establish a single Government-wide coordinated system of procurement regulations under control of OFPP (p. 31)	DOD	May 1974			Aug. 1974	Adopted	P.L. 93-400	Aug. 1974
11. Establish criteria for industry and public participation in procurement rulemaking (p. 38)	DOD	May 1974			Aug. 1974	Adopted	P.L. 93-400	Aug. 1974
Procurement work force:								
12. Make procurement an operational priority with other managerial functions in all agencies (p. 43)	NASA	Nov. 1973		Apr. 1974	(June 1975)			
13. Strengthen role of contracting officer; allow business judgment latitude (p. 44)	NASA	Oct. 1973		Apr. 1974	(June 1975)			
14. Delegate contracting authority to qualified individuals; clarify understanding of authority (p. 44)	NASA	Oct. 1973		Apr. 1974	(June 1975)			
15. Establish through OFPP agency responsibilities and standards for procurement personnel improvement programs and monitoring systems (p. 46)	CSC	Oct. 1973		June 1974	(June 1975)			

Implementation Phase — Executive Branch Action — Type (Target) or actual completion date	GAO Comments on Responsiveness of Executive Branch Actions
	Legend — [R] Position fully responsive; [I] Position not yet established. **Special Management Attention Needed** — [PR] Position partially responsive; [NR] Position nonresponsive; [X] Position established, evaluation deferred in view of proposed implementation; [IX] Position not yet established
	[R] See A-2 comments
	[R] See A-2 comments
system (June 1975)	[X] Passage of OFPP Act, which provides for a coordinated system of Government regulations, constituted executive branch acceptance of this recommendation. In June 1974 GSA asked the interagency task group on this recommendation, which includes the ASPR Committee Chairman and FPR Staff Director, to reconvene to develop an overall system for OFPP to coordinate, control and standardize Government procurement regulations. Also, implementation of A-11 below, directed to timely private sector participation in regulatory formulation, was combined with A-10. Delays have been experienced in obtaining from the task group a suitable approach to an overall regulatory system. The GSA office of Federal Procurement Management recently drafted a proposal for a Federal Procurement Regulatory System and plans to send it out for agency comment in late January 1975. The proposal provides for coordinated FPR/ASPR issuances and advance notice to and consultation with OFPP on major policies and regulations under consideration.
criteria (June 1975)	[X] One of the OFPP functions is to establish criteria and procedures for effective and timely participation of interested parties in the regulatory process. Passage of OFPP Act in August 1974 constituted executive branch acceptance of the recommendation. The interagency task group assigned to this recommendation has been asked to develop an approach for OFPP to implement the recommendation along with A-10 above. (See A-10 comments for progress to date).
	[I] The agencies in general agree to adopt recommendations A-12, A-13, and A-14 which would raise the level of agency procurement management functions and strengthen the qualifications and roles of contracting officers. GSA forwarded to OMB in April 1974 a draft memorandum for issuance to agency heads, requesting those who rely extensively on the contracting function to report in 6 months on corrective measures planned or taken on these three recommendations. Further executive branch action awaits OFPP's achieving operational status.
	[I] See A-12 comments
	[I] See A-12 comments
	[I] Task group concluded that responsibility for developing personnel management programs was an agency role that needed higher priority rather than a role that should be assigned to OFPP. It reworded recommendation D-15 to have a high-level advisory board and program staff established in OFPP to develop and manage an interagency career program for procurement personnel. In June 1974 GSA forwarded this proposed executive branch position and an implementing document to OMB for final decision. Further executive branch action awaits OFPP's achieving operational status.

EXECUTIVE BRANCH POSITIONS AND IMPLEMENTING ACTIONS ON COMMISSION RECOMMENDATIONS AS OF JANUARY 1, 1975

Recommendation (GAO prepared these short-form statements of Commission recommendations. See indicated pages of Commission report for full texts)	Executive Branch Position in Process: Inter-agency task group led by	Executive Branch Position in Process: (Target) or actual date of task group report	Executive Branch Position in Process: Agency/industry comments due or under review	Executive Branch Position in Process: Date referred to OFPP for decision	Executive Branch Position Established: (Target) or actual date	Executive Branch Position Established: Recommendation adopted, modified, or rejected	Implementation Phase, Legislation If Applicable: Bill or law	Implementation Phase, Legislation If Applicable: Date introduced or enacted
PART A--GENERAL PROCUREMENT CONSIDERATIONS: (continued)								
16. Establish procurement recruitment and training program with special attention to college recruitment (p. 47)	CSC	Oct. 1973		June 1974	(June 1975)			
17. Provide better balance between employee tenure and promotion rights and agency needs (p. 48)	CSC	Oct. 1973		June 1974	(June 1975)			
18. Reconcile grade levels to responsibilities and professionalism required (p. 49)	CSC	Dec. 1973	x		(Apr. 1975)			
19. Establish rotation program (p. 49)	CSC	Oct. 1973		June 1974	(June 1975)			
20. Structure longer range personnel programs (p. 49)	CSC	Oct. 1973		June 1974	(June 1975)			
21. Establish a Federal procurement research and training institute (p. 51)	CSC	July 1974	x		(June 1975)			

Implementation Phase — Executive Branch Action: Type	(Target) or actual completion date	GAO Comments on Responsiveness of Executive Branch Actions — Legend		Special Management Attention Needed	
		[R]	Position fully responsive	[PR]	Position partially responsive
		[I]	Position not yet established	[NR]	Position nonresponsive
				[X]	Position established, evaluation deferred in view of proposed implementation
				[IX]	Position not yet established

[I] Task group reworded recommendations A-16, A-17, A-19, and A-20 to upgrade recruiting and training programs without altering their purposes. It did, however, change the manner of implementation. The key change was to require that agencies fulfill existing personnel management responsibilities instead of instituting new requirements. To obtain the necessary priority attention, the task group proposed attaching to the recommendations and implementing documents for executive agencies a special message signed by the President. In June 1974 GSA forwarded the proposed actions and implementing documents to OMB for final decision. These Commission personnel recommendations are allied with a function of the newly created OFPP. This function calls for recommending programs to the Civil Service Commission and executive agencies for recruitment, training, career development, and performance evaluation of procurement personnel. OFPP informed us in December 1974 that these recommendations have been endorsed but that official action will not occur until the OFPP is operational.

[I] See A-16 comments

[IX] Executive branch has tentatively accepted this recommendation. However, proposed implementation is not acceptable to several agencies, including the CSC, which is currently concerned with the grade creep problem in Government generally. CSC said "We cannot agree * * * grades * * * too low, nor * * * that present grades have resulted in any specific personnel management problems, such as recruiting difficulties." In mid-1974, OMB asked GSA to explore the matter further with CSC to resolve the implementation approach. Such action has not been taken to date. GSA plans to confer with CSC in January 1975 to discuss differences prior to referral to OFPP.

[I] See A-16 comments.

[I] See A-16 comments.

[I] Task group proposed adopting this recommendation and, in a July 1974 report outlined basic organizational, financing, and startup plans for a Federal Procurement Institute. The Institute would have a leadership and coordination role in procurement research, education and training, and 10 specific operating functions. One of these functions is to develop and conduct educational and training programs not existing in any Federal agency. The institute is to be operated by the Government rather than by a contractor, with policy and program guidance from an interagency board of directors. The task group favored locating the Institute in GSA, presumably for housekeeping purposes, with the DOD representative dissenting. He favored the Institute's location in DOD because of its dominance in this field. In view of OFPP's newly acquired responsibilities for Government-wide training and research, placing overall responsibility for the Institute under OFPP represents an additional alternative for executive branch consideration. Late in October 1974, the executive branch plan for implementation went to the concerned Federal agencies for official comment. Official agency views reflect the following preferences for location of the Institute: in OFPP--5 agencies; in GSA--10 agencies; in DOD--1 agency; in CSC--1 agency. At a January 1975 meeting with the interagency policy group to establish an executive branch position, DOD opposed the Institute unless located in DOD. DOD agreed to submit an operating plan to GSA on its approach to the Institute. This plan is to be analyzed by GSA, reviewed by its interagency policy group and then referred to OFPP for decision. A final executive branch position is expected in June 1975.

EXECUTIVE BRANCH POSITIONS AND IMPLEMENTING ACTIONS ON COMMISSION RECOMMENDATIONS AS OF JANUARY 1, 1975

Recommendation (GAO prepared these short-form statements of Commission recommendations. See indicated pages of Commission report for full texts)	Executive Branch Position in Process: Inter-agency task group led by	Executive Branch Position in Process: (Target) or actual date of task group report	Executive Branch Position in Process: Agency/industry comments due or under review	Executive Branch Position in Process: Date referred to OFPP for decision	Executive Branch Position Established: (Target) or actual date	Executive Branch Position Established: Recommendation adopted, modified, or rejected	Implementation Phase, Legislation If Applicable: Bill or law	Implementation Phase, Legislation If Applicable: Date introduced or enacted
PART A--GENERAL PROCUREMENT CONSIDERATIONS: (continued)								
Government make or buy decision:								
22. Establish through legislation a national policy of reliance on private enterprise for needed goods and services (with dissent) (p. 57)	OMB	none						
23. Increase $50,000 threshold for the cost comparison requirement to $100,000 (with dissent) (p. 61)	OMB	none						
24. Establish through OFPP criteria for making cost comparisons on fully allocated, rather than incremental, cost basis when work is significant part of workload and Government investment is not substantial (with dissent) (p. 61)	OMB	none						
25. Increase threshold for new starts from $25,000 new capital investment or $50,000 additional annual operating cost to $100,000 (with dissent) (p. 62)	OMB	none						
26. Increase cost differential to justify new in-house starts from 10 percent minimum to 25 percent maximum (with dissent) (p. 62)	OMB	none						

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Implementation Phase		GAO Comments on Responsiveness of Executive Branch Actions	
Executive Branch Action		Legend	
Type	(Target) actual or comple-tion date	[R] Position fully responsive [Y] Position not yet established	Special Management Attention Needed [PR] Position partially responsive [NR] Position nonresponsive [X] Position established, evaluation deferred in view of proposed implementation [IX] Position not yet established

[IX] When the executive branch program started almost 2 years ago, OMB retained the lead task group agency responsibility for developing a report on recommendations A-22 through A-26. These recommendations are concerned with implementation of the national policy of reliance on the private sector for needed goods and services, a policy administered by OMB under Circular A-76. GAO reported in July 1974 that the OMB task group had not developed a report draft or established a completion date. The group has not held a meeting in over a year. GAO recommended that OMB (1) reevaluate the task group effort and membership, (2) insure that a positive program is being actively pursued, and (3) reach agreement with the task group on a completion date. The OMB response to the July report did not reply to this particular recommendation or explain why a reply was omitted. GSA also has been unable to determine the status of the executive branch response to these recommendations. By letter of September 13, 1974, GSA removed itself from any further responsibility for the recommendations. This action was taken in view of Public Law 93-400 which assigned to OFPP the responsibility for overseeing the national policy of reliance on the private sector. OFPP advised GAO in January 1975 that the OMB task group leader has decided not to submit a report, but rather to refer the recommendations to OFPP. OFPP advised further that in lieu of focusing on highly complex and contentious policy issues and legislation (see A-22), OFPP will use its limited resources in the coming year to improve implementation of the present OMB Circular A-76.

[IX] See A-22 comments.

[IX] See A-22 comments.

[IX] See A-22 comments.

[IX] See A-22 comments.

EXECUTIVE BRANCH POSITIONS AND IMPLEMENTING ACTIONS ON COMMISSION RECOMMENDATIONS AS OF JANUARY 1, 1975

Recommendation (GAO prepared these short-form statements of Commission recommendations. See indicated pages of Commission report for full texts)	Executive Branch Position in Process: Inter-agency task group led by	(Target) or actual date of task group report	Agency/industry comments due or under review	Date referred to OFPP for decision	Executive Branch Position Established: (Target) or actual date	Recommendation adopted, modified, or rejected	Implementation Phase: Legislation If Applicable: Bill or law	Date introduced or enacted
PART A--GENERAL PROCUREMENT CONSIDERATIONS: (continued)								
Timely financing of procurement:								
27. Initiate measures to eliminate executive and congressional delays in submitting and considering procurement fund requests and to make funds appropriated available promptly to procuring activities (with dissent) (p. 67)	OMB	Dec. 1973			July 1974	Adopted	P.L. 93-344	July 1974
Selected areas in acquisition process:								
28. Establish Government-wide principles on cost allowability (p. 76)	DOD	May 1974	X		(Mar. 1975)			
29. Make single final overhead settlement binding on all Federal contracts at a given contractor location (p. 77)	DOD	Sept. 1974	X		(June 1975)			

Implementation Phase Executive Branch Action Type. (Target) or actual comple- tion date	GAO Comments on Responsiveness of Executive Branch Actions
	Legend [R] Position fully responsive [I] Position not yet established Special Management Attention Needed [PR] Position partially responsive [NR] Position nonresponsive [X] Position established, evaluation deferred in view of proposed implementation [IX] Position not yet established
See comments	[PR] OMB, which has lead responsibility for this recommendation, has taken the position that the Congressional Budget and Impoundment Control Act of 1974 constitutes a full response. The act, by revising the date for Presidential budget submission and time-phasing key congressional budget decisions, is expected to reduce delays in appropriating funds to the executive branch. An executive branch analysis is not planned or contemplated of whether congressional appropriations, once received, are released timely down through operating levels to the field procuring activities, in accordance with OMB Circular A-34 and agency procedures. For this reason, GAO believes the executive branch action is only partially responsive.
	[I] The task group proposed acceptance of this recommendation for Government-wide cost principles with the provision that a specific set of principles may be required for different private sector categories, such as commercial, universities, and Government-owned contractor-operated facilities (GOCOs). This proposal excludes grant-type cost principles on the basis that they will be the subject of the recommended study under F-2. The task group split over implementation: the majority favored modifying existing organizations; the minority favored creating a new interagency committee within OFPP. The majority position would continue the fragmented cost principle issuances between DOD and civil agencies and relegate the OFPP role to resolving disputes. The GSA staff analysis (1) questioned the task group implementation approach as disruptive, (2) pointed up the need for a responsibility to consider related cost accounting standard issuances, and (3) suggested that responsibility for Federal contract cost principles be centralized within OFPP with a minimum of disruption to existing issuing processes. In July 1974 official agency views were requested on OFPP implementation approaches. To date a consensus of agency views has not developed, and action is being deferred pending receipt of DOD comments.
	[I] Noting the proliferation of separate agency overhead settlements, the task group favored executive branch adoption of recommendation A-29 to use single overhead rates for all Federal contracts at a given contractor location. The group forwarded to GSA in September 1974 an implementing Federal Management Circular addressing Federal grants as well as contracts. The task group report and proposed circular were sent to Federal agencies for official comment in October 1974. Comments had not been received from all agencies at the time of our review. Some of the unresolved issues are (1) whether overhead settlements affecting grants should be included, (2) whether agreement must first be reached on a Government-wide regulatory system and a common set of cost principles as prerequisites for single overhead settlements, (3) whether overhead settlements by one agency would be binding on other agencies, and (4) whether single overhead settlements would affect contracting officer authority and contract appeal procedures.

EXECUTIVE BRANCH POSITIONS AND IMPLEMENTING ACTIONS ON COMMISSION RECOMMENDATIONS AS OF JANUARY 1, 1975

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PART A--GENERAL PROCUREMENT CONSIDERATIONS: (continued)								
30. Establish uniform guidelines for equitable profit objectives in negotiated contracts, emphasizing consideration of capital, risk, complexity, management performance (p. 77)	GSA	Nov. 1974		Jan. 1975	(June 1975)			
31. Evaluate procurement negotiation procedures to compare completed contract results with original profit objectives (p. 78)	GSA	Nov. 1974		Jan. 1975	(June 1975)			
32. Establish a contract payment office for all Federal agencies in each of 10 regional areas (p. 79)	DOD	Apr. 1974			Aug. 1974	Rejected		

Implementation Phase			GAO Comments on Responsiveness of Executive Branch Actions		
Executive Branch Action			Legend		
Type	(Target) or actual completion date			Special Management Attention Needed	
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[IX] The task group report, received in November 1974, proposed that the executive branch adopt recommendations A-30 and A-31 with implementation of A-31 to follow development of the A-30 uniform profit guidelines. The GSA staff analysis accompanying the task group report suggested that, before the executive branch goes on record accepting these two recommendations, it should be reasonably certain that guidelines acceptable to both the executive agencies and their suppliers can be developed within a reasonable time. The reason for this precautionary note was the recently announced failure of DOD's test to consider the extent of capital employed in negotiating profits. One purpose of considering capital employed in negotiating contractor profits is to motivate contractors to invest their own funds in cost-reducing equipment and facilities and to reduce the amount of such equipment and facilities furnished by the Government. Only three contractors volunteered for the DOD test. They found the DOD approach too complex and burdensome to administer. At a December 1974 meeting with the interagency policy group, it was decided that executive branch action should be deferred until a satisfactory implementation approach was developed rather than to forward the task group report for official agency comments at this time. It was decided to refer this recommendation to OFPP and to have OFPP monitor an alternative DOD approach. GSA made this referral in January 1975. (See note a.)

[IX] See A-30 comments

[R] After a detailed survey, the task group proposed rejection of this recommendation to consolidate contract payment offices. Two reasons given were difficulty in separating agency disbursement from related accounting functions and deterioration of personalized and timely service to contractors. Publication of this proposed position in the Federal Register resulted in only three private sector comments, two of which also favored rejection of the recommendation. In August 1974 the executive branch officially rejected the recommendation.

[a] In November 1974 the Comptroller General advised the Secretary of Defense of some reservations about testing the feasibility of a capital-oriented profit policy that was optional on the part of the contractors. He noted that such policy could be expected to initially increase the customary profit rates of some contractors and decrease others. He recommended that the policy be made mandatory on the basis that "sufficient time has elapsed to conclude that the volunteer route does not work."

EXECUTIVE BRANCH POSITIONS AND IMPLEMENTING ACTIONS ON COMMISSION RECOMMENDATIONS AS OF JANUARY 1, 1975

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PART A--GENERAL PROCUREMENT CONSIDERATIONS: (continued)								
33. Establish criteria for estimating costs and benefits of data requirements; make selective after-the-fact reviews to eliminate unnecessary requirements (p. 81)	DOD	Aug. 1974	X		(Mar. 1975)			
34. Establish Government-wide criteria for management systems prescribed for contractor use, including standards for mission-essential data (p. 82)	DOD	Aug. 1974	X		(Mar. 1975)			
35. Stimulate contractor acquisition of production facilities through increased profit and guaranteed amortization of facilities specially acquired for Government programs (p. 86)	DOD	(Feb. 1975)						
36. Authorize by law negotiated sale to using contractor of surplus heavy machine tools and production equipment not needed on full-time basis--with future availability to Government when needed (p. 87)	DOD	Feb. 1974			Mar. 1974	Modified	H.R. 14289	Apr. 1974
37. Establish Government-wide policy for review/approval of cost-type prime contractor procurement systems and transactions (p. 93)	DOD	Nov. 1973			Feb. 1974	Modified		
Procurement of professional services:								
38. Competitively negotiate procurement of professional services with selection based primarily on technical competence and merits of proposed end product rather than fee (p. 98)	HEW	Feb. 1974			June 1974	Adopted		

GAO Comments on Responsiveness of Executive Branch Actions

Legend

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[I] Position not yet established

Special Management Attention Needed
[PR] Position partially responsive
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[IX] Position not yet established

Implementation Phase: Executive Branch Action Type	(Target) or actual completion date	GAO Comments on Responsiveness of Executive Branch Actions
		[I] Task group integrated Commission recommendations A-33 and A-34 to control requirements placed on contractors for product and management data and management systems. In so doing, it redefined the two recommendations into four parts to (1) control development and approval of new requirements, (2) control application of requirements on specific contracts, (3) establish guidance to estimate and analyze the costs and benefits of the requirements, and (4) establish policy for selective after-the-fact reviews to eliminate unnecessary requirements. The task group also developed a draft OMB circular, which provides policy and criteria to implement the recommendations. The circular emphasizes reliance on existing contractor management systems by specifying Government requirements in terms of output (what is required) rather than detailed procedures (how to achieve). The circular is supplemented by a cost-benefit analysis guide to help determine whether management system and data requirements are justified. The task group proposed that the circular complement OMB Circular A-40, which established policies and procedures for control of internal agency, interagency, and public reporting requirements. The task group report and circular is under review by the executive agencies and the private sector. An executive branch position is targeted for spring 1975.
		[I] See A-33 comments
		[I] Task group has been exploring various approaches to stimulate contractor acquisition of production facilities while awaiting the outcome of related actions by the Logistics Management Institute, the task group effort on A-30 profit guidelines, and the Cost Accounting Standards Board. The task group expects to submit its report on this recommendation in February 1975.
		[PR] Executive branch modified this recommendation to confine implementation to DOD and NASA, per legislation introduced several years ago, on the basis that other agencies have not experienced a similar heavy machine tool disposal problem. However, the executive branch did not question other agencies on whether this authority would be useful to them, and official agency views were bypassed. The House and Senate legislative proposals (H.R. 611, S. 2152) relied upon by the executive branch are inactive, and their sponsors are no longer in Congress. A more recent House bill (H.R. 14289) is currently opposed by DOD as too restrictive. For the above reason and because of opposition of the Commission to piecemeal legislation, GAO believes the executive branch position is only partially responsive.
FPR	(Feb. 1975)	[R] Executive branch broadened the recommendation for contractor procurement system approvals beyond cost-type contracts to include noncompetitive contracts when total amount exceeds $5,000,000. ASPR is not subject to major change because DOD already has a program.
FPR/ ASPR	(Nov. 1975)	[R] Executive branch adopted the recommended treatment for competitive negotiation of professional services, but sufficiency of coverage in a proposed implementation document was questioned by GAO and others. One agency said a "broad brush treatment *** does not take aim on the specific problems discussed by the COGP [Commission on Government Procurement]." In July 1974 the executive branch requested the FPR staff and ASPR Committee to amend existing coverage and provided them with a list of areas not sufficiently treated in the task group's proposed implementation. These areas include (1) review/validation of professional services requirements, (2) criteria on when such services may be procured and when not, (3) synopsizing to develop sources, (4) pre-solicitation screening, (5) quality of solicitation document to permit intelligent responses, (6) criteria to evaluate proposals, (7) qualifications of evaluators, (8) technical monitoring of contract performance, and (9) utilization of results.

EXECUTIVE BRANCH POSITIONS AND IMPLEMENTING ACTIONS ON COMMISSION RECOMMENDATIONS AS OF JANUARY 1, 1975

	Executive Branch Position in Process				Executive Branch Position Established		Implementation Phase	
							Legislation If Applicable	
Recommendation (GAO prepared these short-form statements of Commission recommendations. See indicated pages of Commission report for full texts)	Inter-agency task group led by	(Target) or actual date of task group report	Agency/ industry comments due or under review	Date referred to OFPP for decision	(Target) or actual date	Recommendation adopted, modified, or rejected	Bill or law	Date introduced or enacted
PART A--GENERAL PROCUREMENT CONSIDERATIONS: (continued)								
Field contract support:								
39. Establish program to promote interagency use of field contract administration, audit, and other support services (p. 103)	DOD	Apr. 1974			Sept. 1974	Adopted		
40. Transfer to Defense Contract Administration Services military service cognizance of plants not exempted by Secretary of Defense (p. 104)	DOD	Feb. 1974	X		(Apr. 1975)			
41. Separate Defense Contract Administration Services from Defense Supply Agency (p. 105)	DOD	(Feb. 1975)						
42. Consolidate Defense Contract Administration Services and Defense Contract Audit Agency into one Agency reporting directly to Secretary of Defense (with dissent) (p. 107)	DOD	Jan. 1975						

Implementation Phase		GAO Comments on Responsiveness of Executive Branch Actions
Executive Branch Action		Legend
Type	(Target) or actual completion date	[R] Position fully responsive [I] Position not yet established Special Management Attention Needed [PR] Position partially responsive [NR] Position nonresponsive [X] Position established, evaluation deferred in view of proposed implementation [IX] Position not yet established
FMC	See comments	[R] Task group proposed adopting the recommendation to promote and coordinate interagency use of contract administration and audit services with responsibility for implementation of the program to be assigned to GSA. One effect of such a program would be that many civil agencies would be using contract support services of DOD. In June 1974 the task group report, with a proposed Federal Management Circular, was sent to the executive agencies for official comment. (Application of the circular to grant transactions was eliminated as being premature at this time.) Fourteen agencies generally concurred in the proposed position and implementing action, whereas three agencies (Commerce, Environmental Protection Agency and TVA) were reluctant to relinquish administration of their contracts. Two other agencies (AEC and NSF) wanted participation to be voluntary rather than mandatory. In September 1974 the executive branch officially accepted this recommendation but made compliance with the circular voluntary. The first step, which is expected to take about 1 year, is to inventory all field contract administration and audit services and to publish a Government-wide directory. This inventory will highlight the need for better coordination of contract support services and the potential for eliminating and consolidating some activities. The Federal Management Circular to implement the program is to be issued with the directory. GSA officials do not think the program will work on a voluntary basis. They cited a recent communication from the Department of Transportation that it also does not intend to relinquish administration of its contracts.
		[I] Task group proposed rejecting this recommendation for transfer of military service cognizant plants to the Defense Contract Administration Services (DCAS) and substituting an alternative essentially reflecting the program already in existence. GSA asked for private sector comments, but practically no response was recieved. In May 1974 GSA requested DOD official views on the task group position. GSA's request observed that "split contract administration responsibility within DOD could cause a proliferation of internal reports for such mechanized systems as MILSCAP and lead to a crisis of data accumulation." About 80 percent of the tasks carried on within a military plant are not unique. The alternative of joint DCAS/military service representation was not among those examined in the task group report. DOD official views on this matter are expected in February 1975.
		[I] For several months DOD has postponed submission of a task group report to the GSA Office of Procurement Management on recommendation A-41 in order to consider additional input. DOD informed us in late December that the report would be forwarded in February 1975.
		[I] DOD did not submit a task group report on this recommendation to consolidate contract administration and audit activities. By letter of January 16, 1975, DOD asserted its position that no action should be taken on this recommendation. GSA plans to refer the the matter to OFPP for appropriate action.

EXECUTIVE BRANCH POSITIONS AND IMPLEMENTING ACTIONS ON COMMISSION RECOMMENDATIONS AS OF JANUARY 1, 1975

Recommendation (GAO prepared these short-form statements of Commission recommendations. See indicated pages of Commission report for full texts)	Executive Branch Position in Process: Inter-agency task group led by	Executive Branch Position in Process: (Target) or actual date of task group report	Executive Branch Position in Process: Agency industry comments due or under review	Executive Branch Position in Process: Date referred to OFPP for decision	Executive Branch Position Established: (Target) or actual date	Executive Branch Position Established: Recommendation adopted, modified, or rejected	Implementation Phase — Legislation If Applicable: Bill or law	Implementation Phase — Legislation If Applicable: Date introduced or enacted
PART A--GENERAL PROCUREMENT CONSIDERATIONS: (continued)								
National socioeconomic policies implemented through procurement process:								
43. Establish program for legislative and executive reexamination of socioeconomic objectives implemented through procurement process (p. 118)	Labor	Nov. 1973	X		(June 1975)			
44. Raise threshold to $10,000 for applying socioeconomic programs to procurement process (p. 120)	Labor	(Feb. 1975)						
45. Find means to make more visible the socioeconomic costs incurred in procurement process (p. 122)	Labor	Oct. 1973	X		(June 1975)			
46. Revise policies to provide for uniform debarment treatment and broader sanctions for comparable violations of socioeconomic requirements (p. 123)	Labor	(Feb. 1975)						

Implementation Phase Executive Branch Action Type (Target) or actual completion date	GAO Comments on Responsiveness of Executive Branch Actions
	Legend [R] Position fully responsive [I] Position not yet established Special Management Attention Needed [PR] Position partially responsive [NR] Position nonresponsive [X] Position established, evaluation deferred in view of proposed implementation [IX] Position not yet established
[I]	Task group and executive agencies agree in substance on recommendation A-43, to establish a program for legislative/executive branch reexamination of socioeconomic programs and practices that are applied to the procurement process. Three agencies (HEW, AEC, GSA) questioned whether the procurement process was an effective means to implement socioeconomic programs. One agency thought priorities should be established for choosing one socioeconomic program over another where they conflict. The Department of Justice objected to the task group position that legislative branch participation be deferred until the executive branch submitted its report of reexamination. Justice said "it is the duty and responsibility of the Congress to study the present statutory framework upon which the various social and economic programs are founded and to endeavor to modernize and harmonize them to meet current social needs." Because recommendation A-45 is concerned with achieving more visibility over costs and benefits of implementing socioeconomic goals through the procurement process, the executive branch combined the two recommendations. In May 1974 it was decided that GSA would refer recommendations A-43 and A-45 to OMB (before OFPP established) for determination of a proper course of action. Referral had not been made as of January 1, 1975. GSA believes that the results of the A-44 task group effort, expected in February 1975, will assist in resolving A-43 and A-45 and that these related socioeconomic recommendations should be handled as a package.
[I]	Task group led by the Department of Labor has initiated a survey (1) to evaluate the effect on the Service Contract, Davis-Bacon, and related acts of raising the contract value to $10,000 for applying socioeconomic requirements to the procurement process and (2) to support legislative changes. DOD, one of the agencies subject to the survey, refused to participate unless reimbursed the cost of the survey. Labor has attempted to obtain input from DOD through correspondence with the Deputy Secretary of Defense and meetings with his operating officials in the fall of 1974, noting that all Government agencies have a vital interest in the outcome of the study and are cooperating except DOD. Data in some substitute form is now expected from DOD in January 1975. Labor informed us that its task group report will cover 39 socioeconomic programs and will be submitted to the executive branch in February 1975.
[I]	Executive agencies generally questioned the feasibility of measuring the costs of implementing social and economic goals through the procurement process and how meaningful the results would be without measuring the benefits as well, although the benefits are often intangible. This recommendation is to be combined with A-43 and referred to OFPP to determine a course of action. (See A-43 comments for progress.)
[I]	Department of Labor is consolidating its labor statutes and preparing a report on debarment policies for socioeconomic requirement violations. This report is expected to be submitted to the executive branch in February 1975.

EXECUTIVE BRANCH POSITIONS AND IMPLEMENTING ACTIONS ON COMMISSION RECOMMENDATIONS AS OF JANUARY 1, 1975

Recommendation (GAO prepared these short-form statements of Commission recommendations. See indicated pages of Commission report for full texts)	Executive Branch Position in Process				Executive Branch Position Established		Implementation Phase	
	Inter-agency task group led by	(Target) or actual date of task group report	Agency/ industry comments due or under review	Date referred to OFPP for decision	(Target) or actual date	Recommendation adopted, modified, or rejected	Legislation If Applicable: Bill or law	Date introduced or enacted
PART A--GENERAL PROCUREMENT CONSIDERATIONS: (continued)								
Procurement from small business:								
47. Establish new standards for measuring agency and prime contractor performance in using small business (p. 128)	SBA	Sept. 1973	X		(Feb. 1975)			
48. Test feasibility of mandatory small business subcontracting (p. 130)	SBA	Dec. 1973		June 1974	(June 1975)			
49. Initiate executive branch procurement review, with guidance from SBA and OFPP, to enhance small business participation (p. 133)	SBA	Dec. 1973			Apr. 1974	Adopted		

Implementation Phase Executive Branch Action Type (Target) or actual completion date	GAO Comments on Responsiveness of Executive Branch Actions

Legend

[R] Position fully responsive
[I] Position not yet established

Special Management Attention Needed
[PR] Position partially responsive
[NR] Position nonresponsive
[X] Position established, evaluation deferred in view of proposed implementation
[IX] Position not yet established

[IX] In its submission, the SBA-led task group was unable to recommend any new standards to measure agency and contractor performance in promoting small business and opposed implementation. GSA requested the task group to reevaluate its position and suggested several approaches for new standards. The task group made a limited analysis and rejected these approaches in a July 1974 resubmission. Several witnesses, including GAO, took the position during Senate hearings that the calculation of small business participation as a percentage of total contract dollars does not reveal the mix of products and services for which small business can compete. In its report the Senate Small Business Committee stated "there is indeed a need for new standards." The report specifically recommended using a standard of comparing Government and civilian portions of small business awards within individual industries "at least on a temporary limited test basis." In October 1974 GSA asked the private sector, through the Federal Register, to suggest new standards. As of January 1, 1975, several private sector comments had been received and were under review. These comments concur in the need for new standards that are not fixed percentages but rather flexible in nature based on determinations of small business potential. Such an approach is reflected in Public Law 93-438 which established the Energy Research and Development Administration. The act states that small business participation should hinge on a reasonable opportunity to participate and the availability of qualified companies to perform rather than on some mathematical formula. One major company informed GSA that it had developed the means to determine, first, how much of its requirements are within the <u>potential</u> of small business concerns; second, how much <u>opportunity</u> small business had to compete for that potential; and finally, the <u>amount</u> of small business awards as a percentage of that potential.

[I] Task group report of December 1973, noting the decline in small business subcontracting, proposed adoption of this recommendation to test feasibility of mandatory subcontracting. SBA wants the test to include the early design phase because eventual production sources are often established during this phase. DOD opposed this idea because sufficient data would not be available to set goals. The executive agencies, in commenting on the task group report, generally favored implementation of a test program to be performed by DOD and GSA and monitored by OMB. In June 1974 GSA referred this case to OMB (before OFPP established) for final action noting that the Senate Small Business Committee report of March 1974 had endorsed this and other alternatives, such as subcontract set-aside and profit incentive to the prime contractor. OFPP has been awaiting operational status before acting on this referral.

See comments [NR] Executive branch accepted the recommendation to establish a program to enhance small business participation but did not provide an action to accomplish it. The interagency task group proposed acceptance of recommendation but contended that existing programs were adequate. According to the GSA analysis of the task group's position, the critical issue remains:

> "Should a new review of programs be instituted in an effort to provide improvement and to gather the various modes of administration among Federal agencies into more common practices and goals as they relate to small business. The proposed * * *seems to do little but echo the status quo, with limited potential for making small business programs in the Federal Government more effective."

In response to the GAO July 1974 report, OMB said that OFPP will work with SBA and other agencies to reconsider this issue, along with other policies to enhance small business participation in Federal procurement. Action is yet to be initiated.

EXECUTIVE BRANCH POSITIONS AND IMPLEMENTING ACTIONS ON COMMISSION RECOMMENDATIONS AS OF JANUARY 1, 1975

Recommendation (GAO prepared these short-form statements of Commission recommendations. See indicated pages of Commission report for full texts)	Executive Branch Position in Process: Inter-agency task group led by	(Target) or actual date of task group report	Agency/industry comments due or under review	Date referred to OFPP for decision	Executive Branch Position Established: (Target) or actual date	Recommendation adopted, modified, or rejected	Implementation Phase — Legislation If Applicable: Bill or law	Date introduced or enacted
PART B--ACQUISITION OF RESEARCH AND DEVELOPMENT (R&D):								
Federal R&D objectives and organization:								
1. Conduct R&D procurement to be responsive primarily to agency mission needs and then, when possible, to needs of other Federal activities (p. 6)	NSF	Dec. 1973		May 1974	(June 1975)			
2. Allow discretionary use of Government laboratory R&D funds in limited amounts for any national research and development objective (p. 6)	NSF	Dec. 1973		May 1974	(June 1975)			
3. Encourage agencies with R&D missions to generate associated long-range basic research and advanced studies programs (p. 7)	NSF	Dec. 1973		May 1974	(June 1975)			
Performance of R&D:								
4. Strengthen in-house procurement-related technical and management capabilities to support technology advancement in private sector (p. 14)	NSF	Dec. 1973		May 1974	(June 1975)			
5. Continue optional use of federally funded R&D centers to satisfy needs outside organizational resources; reassess need periodically and give special attention to termination provisions when need ceases (p. 16)	DOD	Oct. 1973			Mar. 1974	Adopted		

Implementation Phase: Executive Branch Action Type	(Target) or actual completion date	GAO Comments on Responsiveness of Executive Branch Actions
		Legend [R] Position fully responsive [I] Position not yet established Special Management Attention Needed [PR] Position partially responsive [NR] Position nonresponsive [X] Position established, evaluation deferred in view of proposed implementation [IX] Position not yet established
		[I] Task group report of December 1973 proposed adoption of B-1 through B-4 with minor modifications. These recommendations are concerned with supporting research objectives outside an agency laboratory's normal mission, developing long-range research programs, and strengthening laboratory technical and management capabilities to support private sector technology advancement. The task group concluded that these recommendations generally represent established Government practice. Several of the executive agencies concurred but three (NSA, NPS, and TVA) favored some implementing action. For example, NASA suggested a general R&D policy document to reinforce current practices and incorporate principal points of the task group proposal. In a meeting with the interagency policy group, it was decided that GSA would refer the task group report on B-1, B-2, B-3, and B-4 to OMB, recommending adoption with implementation responsibility to be assigned to NSF or the Federal Council for Science and Technology. Since this referral in May 1974 the report has been under review in OMB. It has deferred action pending OFPP's reaching operational status and a consideration of the interrelationship between these recommendations and those on acquisition of major systems (C-1 through C-12).
		[I] See B-1 comments. Task group proposed a modification of this recommendation to require the Federal agency benefiting from another agency's research "to provide at least partial support on a cost reimbursable basis."
		[I] See B-1 Comments
		[I] See B-1 comments
FMC	(June 1975)	[R] Task group supported this recommendation and drafted preliminary Government-wide guidelines for establishing the need, periodically reviewing the status, and phasing out of Federally Funded Research and Development Centers (FFRDCs). GSA solicited views of six agencies who use FFRDCs and the private sector. The agencies concurred in the need for such guidelines, some noting additional areas warranting coverage. In March 1974 the interagency policy group endorsed action to proceed with implementation. In September 1974 GSA sent to the executive agencies a proposed implementing circular. Except for DOD, the agencies have furnished their comments, with a few suggesting a number of changes. NSF said it could not concur until the circular was amended. When agency comments have been cleared, GSA plans to refer the implementing circular to OFPP for final action.

EXECUTIVE BRANCH POSITIONS AND IMPLEMENTING ACTIONS ON COMMISSION RECOMMENDATIONS AS OF JANUARY 1, 1975

Recommendation (GAO prepared these short-form statements of Commission recommendations. See indicated pages of Commission report for full texts)	Executive Branch Position in Process: Inter-agency task group led by	(Target) or actual date of task group report	Agency/industry comments due or under review	Date referred to OFPP for decision	Executive Branch Position Established: (Target) or actual date	Recommendation adopted, modified, or rejected	Implementation Phase, Legislation If Applicable: Bill or law	Date introduced or enacted
PART B--ACQUISITION OF RESEARCH AND DEVELOPMENT (R&D): (continued)								
6. Monitor NSF and NBS experimental R&D incentives program; translate results into practical application (p. 21)	OMB	no submission			Mar. 1974	Adopted		
R&D procurement policy:								
7. Eliminate restraints on submission of unsolicited proposals by private sector in R&D procurements to encourage flow of creative and innovative ideas (p. 25)	NASA	Nov. 1973			Apr. 1974	Adopted		
8. Eliminate R&D cost sharing except when performers clearly benefit (p. 26)	NASA	Mar. 1974	X		(June 1975)			

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Implementation Phase Executive Branch Action Type	(Target) or actual completion date		GAO Comments on Responsiveness of Executive Branch Actions
			Legend [R] · Position fully responsive [I] Position not yet established Special Management Attention Needed [PR] Position partially responsive [NR] Position nonresponsive [X] Position established, evaluation deferred in view of proposed implementation [IX] Position not yet established
See Comments		[R]	Executive branch ground rules for developing a task group report with a proposed position and an implementation action were not followed in this instance. An OMB March 1974 letter to GSA "requested that the GSA records of executive branch response to recommendations of the Procurement Commission reflect adoption and completed implementation of recommendation B-6." In response to the GAO July 1974 report questioning this procedure, OMB said, because the task group leader on this recommendation was the Deputy Associate Director of OMB for Energy and Science, a task group proposal to GSA would have been superfluous. OMB reiterated its previous comments to GSA that it had established measures to monitor the progress of NSF/NBS experimental R&D incentives program. According to OMB, periodic review and criticism of the planning and execution of the incentives program is now part of OMB's regular budget review and apportionment process for both NSF and NBS.
FPR/ ASPR	(June 1975)	[X]	Task group proposed acceptance of recommendation B-7 to eliminate restraints in procurement practices which discourage submission of unsolicited innovative ideas. Twenty-one of the 23 executive agencies solicited concurred in the task group position, and several provided constructive changes to the proposed implementing guidelines. The executive branch established a position to accept this recommendation, and in May 1974 GSA asked the FPR staff and ASPR Committee to coordinate amendments to their regulations. GSA's letter observed that the negative treatment of unsolicited proposals in the past had diminished the flow of innovative ideas to the Government. In October 1974 DOD agreed to make a "minimum" change to ASPR, incorporating only a policy statement to encourage unsolicited proposals. DOD opposed a stronger regulation being considered by FPR that would prohibit the Government from using, in any new or existing solicitation, unique and innovative ideas found in unsolicited proposals. Issuance of amended regulations is targeted for June 1975.
		[IX]	Commission recommended eliminating <u>all</u> cost sharing except when performers would clearly benefit from the project. The task gouup proposed that the executive branch eliminate <u>required</u> cost sharing but permit <u>voluntary</u> cost sharing to continue and be considered as a factor in cost competitions. NSF dissented, believing that agencies should have the flexibility to require cost sharing in specific instances, such as when supporting rather than procuring research. Comments on the task group proposal from several agencies supported the NSF dissent. As a result, GSA asked the task group in September 1974 to consider these agency views as well as alternatives to its initial proposal. New guidelines being developed by the task group indicate that each agency will be allowed to follow almost any cost sharing practice it prefers and that changes in existing legislative cost-sharing requirements will not be proposed. An executive branch position is targeted for June 1975.

EXECUTIVE BRANCH POSITIONS AND IMPLEMENTING ACTIONS ON COMMISSION RECOMMENDATIONS AS OF JANUARY 1, 1975

Recommendation (GAO prepared these short-form statements of Commission recommendations. See indicated pages of Commission report for full texts)	Executive Branch Position in Process				Executive Branch Position Established		Implementation Phase Legislation If Applicable	
	Inter-agency task group led by	(Target) or actual date of task group report	Agency/industry comments due or under review	Date referred to OFPP for decision	(Target) or actual date	Recommendation adopted, modified, or rejected	Bill or law	Date introduced or enacted
PART B--ACQUISITION OF RESEARCH AND DEVELOPMENT (R&D): (continued)								
9. Eliminate recovery of R&D costs from Government contractors and grantees except those costs related to unusual and expensive programs and approved by agency head (p. 28)	DOT	Sept. 1974			Oct. 1974	Rejected		
10. Establish a policy recognizing that independent R&D and bid proposal costs should receive uniform Government-wide treatment as allowable overhead costs of doing business, with exceptions handled by OFPP (with dissent) (p. 31)	DOD	Nov. 1974	X		(June 1975)			

Implementation Phase Executive Branch Action Type (Target) or actual completion date	GAO Comments on Responsiveness of Executive Branch Actions

Legend

[R] Position fully responsive
[I] Position not yet established

Special Management Attention Needed
[PR] Position partially responsive
[NR] Position nonresponsive
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[IX] Position not yet established

[R] Task group report incorporates the decision of the Council on International Economic Policy, dated August 2, 1974, as Presidential policy on the issue of R&D recoupment. This policy requires the agencies to seek recoupment of their investments in R&D on product sales to any source other than a U.S. Government activity. The policy would provide for:

1. Proportionate cost recovery on product sales, i.e., recovery of only the Government investment in the development of the product.

2. Fair market recovery on technology sales, i.e., recovery of the value of the technology, perhaps exceeding the Government's investment in the development of the technology.

3. Reasonable agency flexibility and discretion in implementation, permitting exceptions because of national interest, foreign policy, and overriding public interest.

DOD will chair an interagency working group to determine appropriate fair market pricing policies and procedures. In view of the foregoing policy decision, the executive branch decided in October 1974 to reject this recommendation.

[IX] In November 1974 GSA received the interagency task group report responding to the Commission recommendation on contractor independent research and development (IR&D) and bid and proposal (B&P) expenses. In a December 1974 meeting, the interagency policy group concurred with the submission of the task group position to the executive agencies and the private sector for comment. The task group proposed rejection of both the Commission's majority and minority recommendations and substituted instead, as a Government-wide standard, those policies and procedures currently contained in the Armed Services Procurement Regulation (ASPR 15-205.3 and .35)--but with three major variations. Analysis of the task group's three variations indicates that differences with the Commission are concerned less with the main directions for change than with the procedures for accomplishing this change.

1. The commission recommended that IR&D and B&P efforts be recognized as necessary costs of doing business because it is in the Nation's best interest to promote competition, advance technology, and foster economic growth. The task group proposed a policy change to broaden the relevancy test for determining IR&D and B&P cost allowability from the buying agency itself to "Government-wide relevency." The task group reasoned that, by not restricting IR&D programs to DOD relevancy, its contractors could look toward other areas as DOD business was phased down. The task group observed that DOD contractors, with their systems background and facilities, might make substantial contributions to resolving such national problems as public transportation, energy, and pollution. It said that strict requirements for relevancy works against the best interest of the Nation by prohibiting the development of needed technology by those most capable of doing so. The task group concluded that present policy "is vague in concept, difficult to administer, and against the best interest of the nation". It should be noted that the main purpose of contractor IR&D is to acquire new business, whether to meet new national needs or obtain new commercial business. The task group report did not discuss the issue of whether IR&D should be recognized as a necessary cost of doing (new) business. If some overhead costs were to be absorbed by new business, it would alleviate one of DOD's highest priority concerns, the skyrocketing overhead cost of the defense industry.

EXECUTIVE BRANCH POSITIONS AND IMPLEMENTING ACTIONS ON COMMISSION RECOMMENDATIONS AS OF JANUARY 1, 1975

Recommendation (GAO prepared these short-form statements of Commission recommendations. See indicated pages of Commission report for full texts)	Executive Branch Position in Process				Executive Branch Position Established		Implementation Phase	
							Legislation If Applicable	
	Inter-agency task group led by	(Target) or actual date of task group report	Agency/ industry comments due or under review	Date referred to OFPP for decision	(Target) or actual date	Recommendation adopted, modified, or rejected	Bill or law	Date introduced or enacted
PART B--ACQUISITION OF RESEARCH AND DEVELOPMENT (R&D): (continued)								

Implementation Phase Executive Branch Action Type (Target) or actual comple-tion date	GAO Comments on Responsiveness of Executive Branch Actions

Legend

[R] Position fully responsive
[I] Position not yet established

Special Management Attention Needed
[PR] Position partially responsive
[NR] Position nonresponsive
[X] Position established, evaluation deferred in view of proposed implementation
[IX] Position not yet established

[IX] 2. The commission recognized that, if less than 50 percent of the contractor's business was competitive, commercial, or fixed price in character, more control would be needed in determining allowability of IR&D costs. The task group said that consideration should be given to applying this principle Government-wide; the group merely differed with the Commission on the 50 percent threshold at which this principle would be applied, believing that insufficient data exists to determine its impact on IR&D cost negotiations.

3. The Commission recommended that IR&D and B&P costs receive uniform treatment Government-wide, with exceptions authorized by OFPP. The task group concurred in this recommendation. It believed that a uniform Government-wide standard should be made applicable to all agencies which rely on a competitive industrial base. The only exception would be that portion of the AEC activities that relies on Government-owned contractor operated (GOCO) laboratories and plants. Other AEC work would be subject to the uniform policy. The AEC dissented with the task group position on this point. AEC expressed a desire to maintain its present policy of nonallowability of IR&D costs unless they can be specifically related to ongoing contract work.

The DOD task group on B-10 did not interrelate IR&D pricing policy with systems acquisition policy, as suggested by another DOD task group on major systems, or address reasons for the increase in IR&D and B&P costs of defense contractors in the 1960s which gave rise to present policies. The Commission believed that these increased costs were symptomatic of underlying problems in the systems acquisition process. This process encouraged contractors to maintain IR&D activities for several years until a baseline system design was approved by the agency. A highly complicated, expensive, and lengthy source selection then followed, which required contractors to maintain design teams in a holding pattern until an award was finally made. Recommendations to alleviate these unnatural pressures on IR&D and B&P expenditures are contained in the Commission's report on Acquisition of Major Systems. (See C-1 thru C-6.) Action on these recommendations would cause industry competitions to start years earlier with direct agency financing of competing R&D solutions to the required mission function rather than financing the agency's in-house design solution.

The task group, in arriving at its position, gave no consideration to the need for a contractual provision that would give the Government sufficient access to a contractor's commercial records to determine whether all IR&D and B&P costs were valid and properly chargeable as indirect costs. A dissenting recommendation of the Commission called for such a provision. The need for the access to records provision is supported by a GAO report (B-164912) to the Congress in December 1974. This report identified a situation where a contractor's IR&D included costs that should have been charged directly to the contractor's commercial business.

A Tri Association position paper, published in March 1974, presents an industry overview of and recommendations on the treatment of IR&D and B&P efforts. These efforts will also be the subject of two pending reports, one by the Defense Science Board and the other by GAO pursuant to Congressional request.

Upon receipt and analysis of agency and private sector views, an executive branch position will be established on recommendation B-10. This action is currently targeted for June 1975.

EXECUTIVE BRANCH POSITIONS AND IMPLEMENTING ACTIONS ON COMMISSION RECOMMENDATIONS AS OF JANUARY 1, 1975

Recommendation (GAO prepared these short-form statements of Commission recommendations. See indicated pages of Commission report for full texts)	Executive Branch Position in Process: Inter-agency task group led by	(Target) or actual date of task group report	Agency/ industry comments due or under review	Date referred to OFPP for decision	Executive Branch Position Established: (Target) or actual date	Recommendation adopted, modified, or rejected	Implementation Phase, Legislation If Applicable: Bill or law	Date introduced or enacted
PART B--ACQUISITION OF RESEARCH AND DEVELOPMENT (R&D): (continued)								
11. Encourage use of standard terms and conditions through master agreements for contracts and grants (p. 46)	AEC	Jan. 1974			May 1974	Adopted		
12. Require senior procurement agency official to justify degree of restraint placed in contractual hardware exclusion provision when potential organizational conflict of interest exists between Government and R&D contractor (p. 47)	AEC	Nov. 1973			Mar. 1974	Modified		

Implementation Phase — Executive Branch Action: Type	(Target) or actual completion date		GAO Comments on Responsiveness of Executive Branch Actions
			Legend — [R] Position fully responsive; [I] Position not yet established. *Special Management Attention Needed*: [PR] Position partially responsive; [NR] Position nonresponsive; [X] Position established, evaluation deferred in view of proposed implementation; [IX] Position not yet established
FPR/ ASPR	(Mar. 1975)	[R]	Task group report proposed adoption of recommendation B-11 to encourage multiagency use of prenegotiated standard terms and conditions (master agreements) with a particular R&D performer except that it would exclude grant-type instruments from these arrangements at the present time. Most executive agencies commenting on the task report concurred but raised a number of issues (1) whether master agreements should be identified with basic agreements and basic ordering agreements, (2) whether master agreements should extend to grant-type situations, (3) whether master agreements should be limited to R&D activities and to nonprofit and educational institutes or include commercial items, (4) whether implementation should be by FMC or directly by FPR/ASPR amendments. and (5) whether a pilot program involving a few agencies and major R&D performers should be undertaken. The executive branch adopted the recommendation, and in July 1974, GSA requested the FPR staff and ASPR Committee to develop appropriate regulatory coverage. GSA forwarded, with the request, the task group report and the GSA staff analysis identifying the unresolved issues. DOD coverage has been drafted and is under review by its field activities. FPR implementation is in process. Issuance of coordinated FPR and ASPR regulations is targeted for March 1975.
FPR/ ASPR	(Aug. 1975)	[R]	Based on task group's proposal and concurring agency comments, the executive branch adopted this recommendation in modified form. The modification expands the Commission recommendation by providing for senior-level review in all instances of potentially unfair competitive advantage as opposed to requiring such reviews only when the hardware exclusion clause is contemplated. Acceptance of this clause excludes the contractor from participating in future hardware development and production of the system his organization conceived. In May 1974 GSA requested the FPR staff and ASPR Committee to develop regulations to implement this recommendation as modified. Issuance of the regulations is targeted for August 1975.

EXECUTIVE BRANCH POSITIONS AND IMPLEMENTING ACTIONS ON COMMISSION RECOMMENDATIONS AS OF JANUARY 1, 1975

PART C--ACQUISITION OF MAJOR SYSTEMS:

OVERVIEW ON PART C RECOMMENDATIONS

Rather than looking at the systems acquisition process in disconnected pieces, the Commission took an integrated view of the total process using a "systems approach" to identify and recommend solutions to problems underlying systems acquisition. It linked 12 interrelated recommendations to a structural framework applicable to acquisition programs of all agencies. The recommendations were not designed to be applied selectively but rather to work together to control the whole.

Interagency group position

In April 1973 the executive branch assigned responsibility to an interagency group, led by DOD, for developing a policy position on the 12 Part C recommendations. Implementation was to be dealt with in a second phase after establishing an official position on the recommendations. In January 1974 the interagency group presented a report to the executive branch on these recommendations. It proposed that the executive branch generally concur in, and each agency adopt, the policy intent of these 12 recommendations, subject to reservations and modifications contained in discussions of the individual recommendations. The group said that the policy framework postulated by the recommendations represents a valuable reference against which all agencies, each in its own context, can continuously examine its system acquisition activity. The group concluded that those recommendations on improved executive/legislative branch relationships offer the greatest potential for improving the system acquisition process and strongly urged that individual agencies explore their implementation with counterparts in OMB and the Congress.

Official agency and industry comments

In March 1974, GSA transmitted the interagency group report to executive agencies for their official comment and subsequently to industry associations for comment. Official agency views basically endorsed or repeated positions of their interagency group members. Other agencies were doubtful that their programs would qualify as major system acquisitions. The Council of Defense and Space Industry Associations (CODSIA) said industry supports the two underlying concepts reflected in the Commission's report that:

1. There should be an integrated system approach to the acquisition of major systems.

2. There are basic policies which can be commonly applied by each agency in its implementation of the acquisition process.

It stressed the need for a total integrated systems acquisition policy for the Federal Government and felt that a formal policy should be paramount in the executive branch position. CODSIA's major reservation about the Commission recommendations was the "unknowns of implementation", including ambiguities and diversity of interpretation. Further, CODSIA referred to problem areas identified in past industry reports which it thought must be considered before CODSIA could concur in any new policy. These problem areas included (1) source selection policy and practices leading to technical leveling, cost auctions, and premature fixed-price arrangements, (2) inflexible requirements in requests for proposals, and (3) the need for better understanding of Government requirements, design-to-cost objectives, and priorities among system performance characteristics (note a).

GAO comments

In its July 1974 report, GAO commented that the greater portion of the interagency group's report prepared by the lead agency (DOD) represented, on the whole, an excellent treatment and interpretation of the Commission recommendations. The GAO report questioned some of the proposed modifications to the Commission recommendations, interpretations of a few, and various claims that the recommendations were already being implemented. Sections of the interagency group's report prepared by the participating civilian agencies (NASA, AEC, DOT, NSF) assumed either that the Commission recommendations applied solely to the DOD environment or that policies of the civilian agencies already incorporated the "spirit" of the recommendations. Civilian agency comments in the interagency report, such as those presented by AEC, did not appear to recognize that the basic steps for acquisition embodied in the recommendations have application to any combination of public and private sector contracting relationships. GAO reviewed its current findings with a key member of the interagency group. He commented that, although the interagency group was only required to develop a policy position, individual members of the group chose to comment on implementation. In his opinion, these comments were premature and in some instances inaccurate. He emphasized that, in the interest of getting on with the next step of developing implementation actions, the group's earlier comments on this subject should be disregarded.

OVERVIEW ON PART C RECOMMENDATIONS (CONTINUED)

GSA referral to OFPP

In January 1975 GSA referred these recommendations to OFPP for decision, along with its analysis of the agency, private sector, and GAO comments. The GSA referral to OFPP outlined two comprehensive alternative approaches to developing agency implementing actions.

1. The first approach would be for OFPP to request the concerned agencies to translate the interagency group's treatment of C series recommendations into implementation actions. Such actions would be cross-indexed to the appropriate C recommendations. The implementing actions would then be reviewed by an interagency group formed by OFPP and led by DOD to determine their responsiveness to the Commission recommendations and to determine whether additional implementation or Government-wide policy statements were necessary. On congressional budget matters, the implementing actions would include procedures to be recommended to the Congress and OMB. GSA pointed out that, since AEC is being assimilated by the Energy Research and Development Agency (ERDA), its earlier comments questioning whether the Commission recommendations were applicable to AEC are no longer valid.

2. The second approach suggested by GSA would involve two steps. In the first step, DOD would develop a model of operational implementation consisting of broad acquisition policies, organizational changes, other implementation impacts, and a diagram of the acquisition cycle. This model would be used by all concerned agencies in the second step to develop proposed implementation. As in the case of the first alternative, an interagency group would then be formed by OFPP and led by DOD to review and validate final actions necessary to implement the recommendations.

Senate inquiry

The Chairman of the Senate subcommittee on Federal procurement sent a letter to the Director of Defense Research and Engineering last summer noting the compatibility of recommendations C-1 through C-12 with DOD's recently issued R&D principles and inquiring about DOD's plans for implementation. The Director replied on July 31, 1974, that, as soon as an executive branch position was established on the recommendations, "effective implementation" would be the next step. In December 1974 hearing to confirm the OFPP Administrator, the Subcommittee inquired as to when this executive branch position would be established. The Administrator was reluctant to furnish a date at the hearings but agreed to furnish some milestones in January 1975. He told the subcommittee that he had had a number of exploratory meetings with agency and industry people, that the basic philosophy and rationale behind the recommendations were accepted by practically everyone, but that there was not yet a clear understanding of the implementation problems.

Conclusion

Because 2 years have elapsed since the Commission made its recommendations, and in view of the vast sums in each year's Federal budget for acquiring major national systems, GAO suggests that OFPP and the executive branch give priority attention to developing policies and implementation actions on these recommendations. As indicated in GAO's individual comments that follow, modifications of some substance have been proposed by the interagency group to elements of Commission recommendations C-3 through C-6. Areas warranting special management attention are discussed under recommendations C-3 and C-4 (proposed modifications) and under recommendations C-11 and C-12 (interpretation of implementation).

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[a]Actually, the Commission accumulated substantial data on each of the problem areas on which CODSIA wants resolutions before agreeing to a new systems acquisition policy. The areas were discussed in the Commission report text of Part C, "Acquisition of Major Systems", and were considered in developing the Commission's final recommendations. For example, technical transfusion that leads to both technical leveling among competing contractors and cost auctions is discouraged by Commission recommendations C-4, C-5, and C-6, permitting each competing contractor to differentiate in his proposed technological solution and to be responsible for his own independent technical and business judgments. If a unique feature proposed by a losing contractor would enhance the winning contractor's technological solution, this feature would not be transfused by the agency; rather, the winning contractor would simply procure the feature directly from the losing contractor who designed it. The key decision would be system selection, not source selection, and this decision would be based on the agency's evaluation of the best combination of mission performance and long-term cost--not amounts proposed by contractors for initial development or production.

EXECUTIVE BRANCH POSITIONS AND IMPLEMENTING ACTIONS ON COMMISSION RECOMMENDATIONS AS OF JANUARY 1, 1975

Recommendation (GAO prepared these short-form statements of Commission recommendations. See indicated pages of Commission report for full texts)	Executive Branch Position in Process: Interagency task group led by	(Target) or actual date of task group report	Agency/industry comments due or under review	Date referred to OFPP for decision	Executive Branch Position Established: (Target) or actual date	Recommendation adopted, modified, or rejected
PART C--ACQUISITION OF MAJOR SYSTEMS: (Continued) Needs and goals for new major acquisition programs:						
1. Start new system acquisition programs with assignment of agency component responsibility and with needs and goals which are (1) stated by agency head independently of any system product, (2) reconciled with overall agency capabilities and resources, and (3) specified in terms of anticipated total mission cost, projected capability level, and expected time for achievement (p. 109)	DOD	Jan. 1974		Jan. 1975	(June 1975)	
2. Provide appropriate congressional committees with annual review of missions, capabilities, deficiencies, and new acquisition needs and goals as basis for reviewing agency budgets (p. 109)	DOD	Jan. 1974		Jan. 1975	(June 1975)	

Implementation Phase				GAO Comments on Responsiveness of Executive Branch Actions
Legislation If Applicable		Executive Branch Action		Legend
Bill or law	Date intro-duced or enacted	Type	(Target) or actual comple-tion date	[R] Position fully responsive [I] Position not yet established Special Management Attention Needed [PR] Position partially responsive [NR] Position nonresponsive [X] Position established, evaluation deferred in view of proposed implementation [IX] Position not yet established
				[I] Interagency group proposed executive branch adoption of this recommendation for preceding new programs with statements of needs and goals that are independent of any system product and reconciled to agency capabilities, deficiencies, and long-term resources. It recognized that under current procedures most annual budget submissions to the Congress are oriented toward hardware rather than to mission problems. The group said adoption of the recommendation was subject to (1) each agency's agreeing with their OMB and congressional counterparts on definition and identification of "missions" and (2) recognition of the limitations in long-range mission projections of capabilities, deficiencies, and cost. The group said implementation of this recommendation "would force more direct and very early agency consideration and decision on the tentative allocations of resources against identified mission deficiencies (within agencies) as well as against other identified national needs and goals (by Congress)." It observed that, while existing procedures could be refined to adopt this recommendation, such action "must be consistent and integrated with actions resulting from the other eleven recommendations." (underlining supplied) The GSA staff analysis, accompanying the January 1975 referral of this recommendation to OFPP suggested that agencies proceed with the development of responsive implementation plans and that the agencies cite the types of procedures they would recommend for the Congress and OMB.
S. 1414 P. L. 93-344	Mar. 1973 July 1974			[I] Interagency group proposed executive branch adoption of this recommendation for annual congressional budget review of new program needs and goals within the context of agency missions, capabilities, and deficiencies. This would fundamentally change how the Congress now receives, reviews, and authorizes agency budgets. The group recognized that "current procedures * * * may have to be expanded or realigned * * *. Satisfactory implementation procedures, as required, should be worked out by each agency with its OMB and congressional counterparts." It said "this approach would provide to Congress a comprehensive review of agency needs and goals at a higher level of consideration than normally occurs during detailed budget hearings. The information needs of Congress for this purpose are recognized and should be supported. Continued improvements in the dialogue between the agencies and the Congress and a better understanding by the Congress of agency needs and goals in the acquisition of major systems is a highly desirable objective." It should be noted that the Congress has taken an initial step in this direction with the enactment of Public Law 93-344, the new Congressional Budget and Impoundment Control Act. The act will require the President to begin presenting in the late 1970s a top-down budget organized by national needs, agency missions, and basic programs to accomplish these missions (Title VI, Sec. 601(i)). The GSA staff analysis accompanying referral of the recommendation to OFPP in January 1975 suggested that, since there is a general consensus to accept the recommendation, the proposed agency implementation action should proceed as discussed under C-1, considering as well the role of Congress and OMB.

EXECUTIVE BRANCH POSITIONS AND IMPLEMENTING ACTIONS ON COMMISSION RECOMMENDATIONS AS OF JANUARY 1, 1975

Recommendation (GAO prepared these short-form statements of Commission recommendations. See indicated pages of Commission report for full texts)	Executive Branch Position in Process: Inter-agency task group led by	(Target) or actual date of task group report	Agency/industry comments due or under review	Date referred to OFPP for decision	Executive Branch Position Established: (Target) or actual date	Recommendation adopted, modified, or rejected
PART C--ACQUISITION OF MAJOR SYSTEMS: (Continued)						
Exploring alternative systems:						
3. Support technology-based activities of agency missions, but do not fund fully designed hardware for subsystems until they are identified as part of system candidates to meet specific operational needs (p. 133)	DOD	Jan. 1974		Jan. 1975	(June 1975)	
4. Create alternative system candidates within stated needs and goals for new acquisition programs by soliciting proposals from industry, including smaller firms with production potential, and by sponsoring most promising ones selected by agency component head using team of experts (p. 133)	DOD	Jan. 1974		Jan. 1975	(June 1975)	

Implementation Phase				GAO Comments on Responsiveness of Executive Branch Actions
Legislation If Applicable		Executive Branch Actiion		Legend
Bill or law	Date intro- duced or enacted	Type	(Target) or actual comple- tion date	[R] Position fully responsive [I] Position not yet established Special Management Attention Needed [PR] Position partially responsive [NR] Position nonresponsive [X] Position established, evaluation deferred in view of proposed implementation [IX] Position not yet established

[IX] Interagency group proposed executive branch adoption of this recommendation for supporting mission-oriented, technology-based activities except for the restriction on subsystem development. It acknowledged that the prudent course was to pursue subsystem development with a system goal in mind but also to seek use of proven hardware and commonality so that a subsystem could be used in more than one system. Since a major thrust of the Commission's interrelated C series recommendations is to encourage competitive system concepts and preliminary designs that incorporate existing subsystems to the extent they enhance the supplier's competitive position, GAO questions whether there is a real difference between the interagency group and Commission positions. Carrying new subsystems too far into final development cuts off competition for alternative approaches and designs and can lead to acquisition before a need for that system has been established. Prespecified subsystems constrain the system designer's latitude and restrict competition. GAO believes the group's modification is therefore inappropriate. The GSA staff analysis, accompanying referral of this recommendation to OFPP in January 1975 suggests that agencies be asked to develop implementation so that differences between the interagency group and Commission intent can be assessed.

[IX] Interagency group agreed with the thrust of this recommendation to stimulate greater innovation and create a broad range of alternative system solutions from which to select those most deserving of further development. It concluded that the general approach recommended by the Commission should be pursued when a significant departure from existing hardware is desired and when true innovation should be stimulated. GAO questions whether the need for innovation can be predetermined particularly in view of the Commission's expressed concern about stretching old technology to exorbitant cost levels.

The group raised two potential problems of administration. It assumed "that the very process of stimulating innovation will stimulate concepts and development effort which will be progressing or maturing at perhaps widely differing rates. The practical problem then emerges of evaluating the several competing efforts at a given point in time and rendering equitable judgments and decisions as to which should be continued, accelerated, slowed down, etc." GAO believes this problem is not new. To the extent that agencies have previously created system alternatives, agencies have always been faced with the practical problem of making difficult choices between various concepts and technical approaches with differing degrees of development effort and completion dates--choices that were based primarily on paper analyses. This Commission recommendation simply puts more emphasis, first, on creating system alternatives and, second, on extending into an exploratory development and testing phase those alternatives deserving consideration. The aim of the Commission was to inject private enterprise competition into consideration of alternatives and to acquire better information in terms of hardware development and test results from which to choose a system design solution. It would seem therefore, that the Commission's recommendation would reduce the problem of dealing with different system solutions and improve system design choices.

EXECUTIVE BRANCH POSITIONS AND IMPLEMENTING ACTIONS ON COMMISSION RECOMMENDATIONS AS OF JANUARY 1, 1975

	Executive Branch Position in Process				Executive Branch Position Established	
Recommendation (GAO prepared these short-form statements of Commission recommendations. See indicated pages of Commission report for full texts)	Inter-agency task group led by	(Target) or actual date of task group report	Agency/ indus-try comments due or under review	Date referred to OFPP for decision	(Target) or actual date	Recommen-dation adopted, modified, or rejected

PART C--ACQUISITION OF MAJOR SYSTEMS: (Continued)

Implementation Phase

Legislation If Applicable		Executive Branch Action		GAO Comments on Responsiveness of Executive Branch Actions
Bill or law	Date introduced or enacted	Type	(Target) or actual completion date	Legend: [R] Position fully responsive; [I] Position not yet established. Special Management Attention Needed: [PR] Position partially responsive; [NR] Position nonresponsive; [X] Position established, evaluation deferred in view of proposed implementation; [IX] Position not yet established

[IX] The second problem of administration raised by the group was whether the agency component head could personally review and select system candidates to be sponsored with agency funding. To overcome this problem the Commission suggested using a team of experts from inside and outside the agency, with the agency component head approving only the candidates to be funded.

The interagency group modified one part of the recommendation which allows for industry participation from other than major companies and deleted the Commission criteria for determining eligibility of smaller firms. The purpose of this part of the recommendation is to allow small groups of talented engineers, whether from large or small companies. to create concepts and develop hardware. If a smaller company competes successfully, it could then form an association with a reputable manufacturer to produce the system or could grow on the basis of competitive merit and eventually do its own production. The traditional practice of requiring potential contractors that make proposals to possess production capabilities which may or may not be needed has limited competition and resulted in agencies sponsoring only large companies (who were once small firms). The Commission wanted to reduce the barriers for new entries and strengthen the competitive forces in industry. For these reasons, GAO believes that recommendation C-4 should not be modified as proposed. The GSA staff analysis accompanying referral of this recommendation to OFPP in January 1975 suggests that agency implementation be initiated and the proposed modification be resolved during that phase.

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PART C--ACQUISITION OF MAJOR SYSTEMS: (continued)						
5. Finance exploration of most promising alternative system candidates by (1) proposing, authorizing, appropriating, and allocating R&D funds according to agency mission need and (2) monitoring funds through annual budget reviews (p. 133)	DOD	Jan. 1974		Jan. 1975	(June 1975)	
Choosing a preferred system:						
6. Maintain competition between system exploration contractors by (1) limiting commitments to annual fixed-level awards subject to technical progress reviews, (2) assigning operational agency representatives to advise contractors, and (3) concentrating agency development and technical organization efforts on monitoring, testing, and evaluating contractor efforts. (p. 133)	DOD	Jan. 1974		Jan. 1975	(June 1975)	

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Implementation Phase					GAO Comments on Responsiveness of Executive Branch Actions
Legislation If Applicable		Executive Branch Action			Legend
Bill or law	Date intro-duced or enacted	Type	(Target) or actual comple-tion date		[R] Position fully responsive [I] Position not yet established Special Management Attention Needed [PR] Position partially responsive [NR] Position nonresponsive [X] Position established, evaluation deferred in view of proposed implementation [IX] Position not yet established
S. 1414	Mar. 1973			[I]	Interagency group proposed executive branch adoption of this recommendation for budgeting and financing exploratory development of competing system candidates for a new mission before a commitment is made to a specific solution. It recognized that the recommendation is basically sound and that satisfactory implementation procedures must be worked out by each agency and its OMB and congressional commitee counterparts. The group said that NASA's R&D budget is mission-oriented but that other agency budget requests are more oriented to program hardware requirements. The group modified the Commission recommendation by substituting "agency component" for "agency" in two places. The GSA staff analysis observed that: "The rationale for * * * modifications * * * isn't explained * * *. While these modifications would not appear to affect the thrust of the intent of the recommendation, it has been observed that allowing agency components to propose their own development budgets, etc. could result in unjustified duplicative and overlapping development efforts (e.g. interservice rivalry). In order to fully appreciate and assess the differences in the ISG's [interagency group] and Commission's wording of the recommendation, we would suggest that agencies be requested to develop proposed implementation." GSA noted also that, in the case of C-2, implementation of this recommendation will be influenced by provisions of the new Congressional Budget and Impoundment Control Act requiring the President's annual budget to be organized by national needs, missions and basic programs to accomplish these missions.
P. L. 93-344	July 1974				
				[I]	Interagency group proposed executive branch adoption of this recommendation to sustain competitive system design efforts into hardware development and test stages, on the basis that more meaningful competition would result in better systems being obtained more quickly and economically. The group concluded that the undesirable acquisition environment and results described in the Commission's report were largely due to two underlying problems: (1) premature system definitions and (2) the workings of the congressional authorization and appropriation process which contribute to premature system definition. The Group suggested two modifications. It prefers the terminology "funding design contractors at planned levels" because the Commission's terminology, "fixed level awards," is not in current use and thus not well understood, and it does not want to adopt the idea of a fixed dollar ceiling. The Commission report indicates that fixed dollar ceilings could and should be used because relatively short periods of incremental performance were envisioned at the beginning of new programs and because it is necessary to provide cost control during these early highly competitive efforts. The Group's other modification removed the requirement that onsite agency operational inputs would be made to the competing contractors on an advisory basis and substituted "encouraging appropriate interaction between agency representatives with relevant operational experience and a contractor as necessary in developing performance and other requirements for each candidate system as tests and tradeoffs are made". In support of this modification, the interagency group presented an interesting discussion on the difficult line that agency representatives must walk between providing assistance to a contractor on one hand and conferring an unfair competitive advantage to him on the other hand. The GSA staff analysis accompanying referral of the recommendation to OFPP in January 1975, accepts the interagency group's

EXECUTIVE BRANCH POSITIONS AND IMPLEMENTING ACTIONS ON COMMISSION RECOMMENDATIONS AS OF JANUARY 1, 1975

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PART C--ACQUISITION OF MAJOR SYSTEMS: (continued)						
7. Limit premature commitments and maintain system-level competition through field demonstration by (1) having selected contractors prove chosen technical approach is sound and system definition of candidate system is practical before final development, production, and operational use commitments, (2) providing them with final operational test, mission performance, and life-time ownership cost evaluation criteria, and (3) strengthening agency's life cycle cost estimating capability (p. 143)	DOD	Jan. 1974		Jan. 1975	(June 1975)	
8. For systems chosen without competing candidates, obtain agency head approval, integrate technical and management contributions from in-house groups and contractors, establish strong tachnical and management control program office, select contractors for proven capabilities, and estimate program cost within a probable range (p. 143)	DOD	Jan. 1974		Jan. 1975	(June 1975)	

[a]A recent Navy Instruction (OPNAVINST 5000.42, June 1, 1974) addresses "Weapon Systems Selection and Planning" and has been represented as the Navy's latest thinking in the area of requirements determination and as incorporating the thrust of the Commission recommendations (Admiral Hollaway's letter to Chairman of the Ad Hoc Subcommittee on Federal Procurement, dated Sept. 13, 1974.) However, this new instruction still allows initial operational requirements to be stated in terms of individual system characteristics such as range, speed, maneuverability, and firing rates, thereby dictating or limiting product solution and preempting competing design alternatives. The instruction does not provide guidance for creating and exploring alternatives or for sustaining those in competition that warrant further development nor does it define the roles of agency and industry in formulating concepts and preliminary designs. If the thrust of the Commission recommendations were recognized in this instruction, policy guidance would be oriented toward stating agency operational requirements in terms of functions to be performed within specified operational environment(s), so as to permit a wide span of technical solutions to be initially created and explored.

Implementation Phase				GAO Comments on Responsiveness of Executive Branch Actions
Legislation If Applicable		Executive Branch Action		Legend
Bill or law	Date introduced or enacted	Type	(Target) or actual completion date	[R] Position fully responsive [I] Position not yet established Special Management Attention Needed [PR] Position partially responsive [NR] Position nonresponsive [X] Position established, evaluation deferred in view of proposed implementation [IX] Position not yet established

rationale for these two modifications but points out that, as in other cases, development of actual implementation will demonstrate the extent of compliance with the intent of the Commission's recommendation.

[I] Interagency group proposed executive branch adoption of this recommendation for competitive demonstration of candidate systems on the basis that the recommendation is "desirable, and should be pursued by various agencies more consciously than is perhaps currently the case." The group concurred with the Commission finding "that the choice of a system and the writing of its requirements often occur too early in the R&D process before meaningful exploration of technical alternatives has taken place" (note a). It observed that changes made by agencies to use competitive system demonstrations will require improvements to the budget-funding process, which depends on congressional action. The GSA staff analysis accompanying referral of the recommendation to OFPP in January 1975 noted the general consensus on this recommendation and suggested that implementation be initiated.

The group clarified one part of this recommendation to show that lifetime ownership costs would be only one factor in choosing preferred systems. It expressed concern over agency ability to estimate future system operating and maintenance costs because of the unavailability of such data from current cost accounting systems. The Commission report indicates that it was not seeking either precise projections in this area or prior systems' cost accounting data but, rather comparative approximations based on actual field data collected from development and operational test phases of candidate systems.

[I] Interagency group proposed executive branch adoption of this alternative noncompetitive acquisition strategy, recognizing that competitive demonstration of system solutions is not always feasible and that multibilion dollar acquisition programs of great urgency are more effectively managed by a strong centralized program office. As GAO noted in its July 1974 report, the group did not discuss the Commission criteria which severely limits the use of this single-source acquisition strategy to rare exceptions: those programs of great urgency and massive physical and financial magnitude. GSA's staff analysis, accompanying referral of this recommendation to OFPP in January 1975 suggested that agencies, in developing their proposed implementation, include criteria for using the noncompetitive systems acquisition approach.

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PART C--ACQUISITION OF MAJOR SYSTEMS: (continued)								
System implementation:								
9. Withold agency and congressional commitments for full production pending reconfirmation of need and system performance test and evaluation; establish operational test activity separate from developer and user, define scope of operational testing agencywide, and strengthen operational testing capabilities (p. 166)	DOD	Jan. 1974		Jan. 1975	(June 1975)			
10. Use contracting as system acquisition tool, not management substitute; set guidelines to permit flexibility in applying contracting regulations, including use of simplified final development and production contracts and priced production options when critical test milestones have minimized risk (p. 171)	DOD	Jan. 1974		Jan. 1975	(June 1975)			

Implementation Phase — Executive Branch Action: Type (Target) or actual completion date	GAO Comments on Responsiveness of Executive Branch Actions
	Legend [R] Position fully responsive [I] Position not yet established Special Management Attention Needed: [PR] Position partially responsive [NR] Position nonresponsive [X] Position established, evaluation deferred in view of proposed implementation [IX] Position not yet established

[I] Interagency group proposed executive branch adoption of this recommendation, noting that the strongest support for adoption comes from DOD. DOD pointed out that the basic part of the recommendation--to withhold agency and congressional approval of full production until a newly developed system has been operationally tested and the need reconfirmed--is satisfied by requirements specified in DOD Directives 5000.1 and 5000.3, the latter being approved almost simultaneously with publication of the Commission report, and by section 506 of Public Law 92-156. With respect to establishment of independent operational test and evaluation activities in each agency, DOD said that the Army and Navy have complied fully and that, as a result of a recent decision, the Air Force intends to follow suit. Further discussion was provided on current efforts to strengthen testing capabilities, including additional funding, better test plans, and improved targets, instrumentation, and data analysis.

Group members of two civilian agencies, however, argued against individual parts of the recommendation as not literally applying to their situations. For example, DOT said its components do not have a large enough operation to warrant each having a separate test and evaluation activity. GAO believes the Commission was emphasizing the need for an independent operational test of a newly developed system rather than necessarily directing how each agency should organize to accomplish this objective. GAO suggested in its July 1974 report that a more positive response by civilian agencies is possible if they focus on the basic intent and principles imbodied in the recommendation (note a). The GSA staff analysis provided to OFPP in January 1975 suggested that, in view of the general executive branch consensus to adopt the recommendation, the next step would be for agencies to develop and submit responsive implementation plans.

[I] Interagency group proposed executive branch adoption of this recommendation (it deleted three insignificant words). It recognized that the recommendation is designed to unburden the administrative and management processes associated with major system acquisitions and that, with such changes as competitive prototyping, new and simplified contract clauses could minimize contracting and administrative complexities for both Government and contractor officials. It said the degree of simplification would be governed by public accountability restrictions, but recognized that, if earlier steps in the acquisition process are well done, simpler final development and production contracts can be developed and extensive Government controls and detailed interaction with the contractors can be reduced. With respect to priced production options, the interagency group said the key is prudent use within an incremental acquisition approach that emphasizes competitive prototyping. The group alleged that "agencies are practicing, where appropriate, the policies advocated * * *." The GAO July 1974 report noted that this conclusion was not supported by citing implementing documents or examples of actual practice. The GSA staff analysis accompanying the referral of this recommendation to OFPP in January 1975 suggested that the next step would be for the agencies to develop responsive implementation documents and/or examples of actual practice.

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[a] A member of the interagency group advised GAO that if the group had dropped the words "in each agency component" from the recommendation, this could have forestalled civil agency objections.

EXECUTIVE BRANCH POSITIONS AND IMPLEMENTING ACTIONS ON COMMISSION RECOMMENDATIONS AS OF JANUARY 1, 1975

Recommendation (GAO prepared these short-form statements of Commission recommendations. See indicated pages of Commission report for full texts)	Executive Branch Position in Process: Inter-agency task group led by	(Target) or actual date of task group report	Agency/industry comments due or under review	Date referred to OFPP for decision	Executive Branch Position Established: (Target) or actual date	Recommendation adopted, modified, or rejected	Implementation Phase — Legislation If Applicable: Bill or law	Date introduced or enacted
PART C--ACQUISITION OF MAJOR SYSTEMS: (continued)								
11. Unify major acquisition policy and monitoring at agency and component management levels; integrate technical and business management policy; assign program managers upon program initiation; institute career program to insure varied and enlarged personnel experience; and reduce agency and industry management layering, reviews, procedures, reporting, and paperwork (p. 178)	DOD	Jan. 1974		Jan. 1974	(June 1975)			
12. Delegate technical and program decision authority to operating agency components, except for key agency head decisions for program needs and goals and for approving systems for demonstration, final development, and full production (p. 178)	DOD	Jan. 1974		Jan. 1975	(June 1975)			

Implementation Phase Executive Branch Action Type (Target) or actual comple-tion date	GAO Comments on Responsiveness of Executive Branch Actions Legend	
	[R] Position fully responsive [I] Position not yet established	Special Management Attention Needed [PR] Position partially responsive [NR] Position nonresponsive [X] Position established, evaluation deferred in view of proposed implementation [IX] Position not yet established

[IX] Interagency group proposed executive branch adoption of this recommendation, pointing out that "several agencies have recognized the need for unified policymaking and monitoring responsibilities for major system acquisitions and have organized to assure that business and technical considerations are applied in an integrated fashion." The group said acquisition review councils within DOT (TSARC) and DOD (DSARC) "offer such a means." The group volunteered its opinion that the agencies have implemented the substance of the recommendation to the extent practical and advantageous to do so. It said additional management entities will not necessarily improve the management system. While agency top management review councils do meet a few times during the life of a program, GAO believes that the Commission recommendation calls for more day-to-day interaction and integration of technical and business management aspects of agency head and component system policy and monitoring functions. The Commission report seems clear that fewer management entities were envisioned, not more (see vol. 2, Part C, pp. 172-176). The Commission acknowledged the existence of the various acquisition review councils when making its recommendation. Its concern was that those review councils still leave in place the separation of system technical and business policy functions and decisionmaking which, in turn, perpetuate management layering, staff reviews, coordinating points, and paperwork down through an immense organizational structure. The interagency group report seems to interpret the recommendation in such a manner as to maintain the status quo. The GSA staff analysis accompanying referral of this recommendation to OFPP in Jnauary 1975 suggested that in "developing implementing actions the agencies should examine their existing structures with a view towards the Commission's intent of minimizing management layering and the possible unifying of technical and business policy and monitoring activities at agency and component headquarters levels."

[IX] Interagency group proposed executive branch adoption of this recommendation for agency head decisions on four key turning points in new acquisition programs--approving (1) mission need and acquisition goals, (2) alternative systems for competitive demonstration, (3) preferred system for final development, and (4) full production release. However, it added that "the several agencies [represented on the interagency group] have developed and implemented policies and procedures designed to accomplish the objectives of the Recommendation". The group recognized that the production decision is not applicable to some AEC and DOT components.

The Commission matched the key decisions in its recommended systems acquisition framework against the key decisions currently in use by some agencies and found similarities in the back-end of the process and substantial differences in the front-end of the process (see Part C, p. 142). For example, under the delegation authorized in DOD Directive 5000.1 (note a), new programs do not have to be exposed to the agency head until long after their need has been established and several years effort expended by the agency component toward one technological solution. The effect is to (1) limit agency head and congressional visibility on decisions that start new programs and explore alternatives and (2) restrict private enterprise competition to the design details and cost of one given agency solution. (See also note a under discussion of recommendation C-7.) The Commission went to great lengths to point out that the earlier decision points, although involving only minor expenditures, are fundamental to agency head/congressional control, as well as to the rational evolution of major programs. As recommendation C-12 provides the key decisions for the overall systems acquisition framework, and as these decisions are embodied in other Part C recommendations already accepted by the interagency group, GAO believes that implementation of C-12 should receive the highest consideration. The GSA staff analysis accompanying referral of this recommendation to OFPP in January 1975 noted the absence of documentation supporting the group's claim of implementation. It suggested that agencies be asked to develop responsive implementing actions and/or examples of actual practice.

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[a] As recently amplified by Department of Defense Instruction 5000.2, dated January 21, 1975

EXECUTIVE BRANCH POSITIONS AND IMPLEMENTING ACTIONS ON COMMISSION RECOMMENDATIONS AS OF JANUARY 1, 1975

Recommendation (GAO prepared these short-form statements of Commission recommendations. See indicated pages of Commission report for full texts)	Executive Branch Position in Process: Inter-agency task group led by	(Target) or actual date of task group report	Agency/industry comments due or under review	Date referred to OFPP for decision	Executive Branch Position Established: (Target) or actual date	Recommendation adopted, modified, or rejected	Implementation Phase, Legislation If Applicable: Bill or law	Date introduced or enacted
PART D--ACQUISITION OF COMMERCIAL PRODUCTS:								
Commercial products marketplace;								
1. Improve collection and dissemination of commodity and agency procurement statistics for congressional, executive branch, and industry needs (p. 5)	GSA	Dec. 1973			May 1974	Adopted	P.L. 93-400	Aug. 1974
Commercial products requirements:								
2. Provide means for users to communicate extent of satisfaction with centralized supply support system in order to evaluate its effectiveness (p. 17)	GSA	Apr. 1974			May 1974	Adopted		

Implementation Phase — Executive Branch Action: Type	(Target) or actual completion date	GAO Comments on Responsiveness of Executive Branch Actions
		Legend [R] Position fully responsive [I] Position not yet established Special Management Attention Needed [PR] Position partially responsive [NR] Position nonresponsive [X] Position established, evaluation deferred in view of proposed implementation [IX] Position not yet established
FMC	(Apr. 1976) to (Apr. 1977)	[R] A standing interagency "Federal Procurement Data System Committee" is working on the implementation of this recommendation. The committee is chaired by a member of the GSA Office of Procurement Management as executive agent for the OFPP Administrator. The OFPP Act made this implementation a functional responsibility of the Administrator by requiring establishment of a system to collect, develop, and disseminate executive agency procurement data that satisfies the needs of the Congress, the executive branch, and the private sector. The committee's charter states that the committee is to assist the executive branch in designing and recommending a centralized system that will be efficient and economical, as well as responsive to these needs, with a capability of merging and retrieving data from various Government agencies. The committee is also responsible for coordinating, testing, and overseeing implementation of the system and for determining annually the data elements to be collected by the agencies in the ensuing fiscal year. As authorized in the charter, the committee established two standing subcommittees to perform specific tasks in development of the system--System Design and Data Processing. The System Design Subcommittee is responsible for designing the system, which includes proposing the kinds of procurement transactions to be included and excluded from the system, data elements to be reported, means for reporting and for agency implementation, and a system for overview and annual review of data elements. The Data Processing Subcommittee is responsible for the establishment and operation of the central data repository and processing function, which includes proposing means and instructions for agency reporting of data to the repository. Subcommittee task orders call for submission of monthly status and progress reports to the committee chairman. The target date for completion of the system design is presently April 1, 1975. The operational target date for the entire system is October 1, 1975, with a maximum delay date of October 1, 1976, and an initial data output 6 months after the system becomes operational. Both GAO and the committee recognize that two major problems will be encountered in designing and establishing a system responsive to procurement data needs of the Government and the private sector. The first is making the system compatible with other agency systems, particularly DOD's which accounts for more than 75 percent of the Government's procurement dollars. The second is making the system flexible enough to accomodate the many future legislative changes anticipated in the procurement area.
FMC	Dec. 1974	[R] In December 1974, the GSA Office of Federal Management Policy issued a circular (FMC 74-10) to all executive departments and agencies specifying policies and procedures to be established to insure user satisfaction with supply support systems. The circular requires the head of each agency operating one or more supply support systems to establish procedures for periodic reviews of existing methods of expressing end product user's satisfaction with the system(s). If improvements are warranted, consideration is to be given to (1) establishing supply liaison programs, including the use of publications to assist the users, (2) coordinating proposed procedures with end product users before implementation, and (3) conducting meetings and seminars with users to obtain direct feedback regarding the system. Each agency is to advise GSA within 180 days on steps taken to implement the circular. Effective implementation of this recommendation will depend, in part, on the extent to which steps taken by individual agencies are reviewed, evaluated, and monitored by GSA as executive agent for OFPP.

EXECUTIVE BRANCH POSITIONS AND IMPLEMENTING ACTIONS ON COMMISSION RECOMMENDATIONS AS OF JANUARY 1, 1975

Recommendation (GAO prepared these short-form statements of Commission recommendations. See indicated pages of Commission report for full texts)	Executive Branch Position in Process				Executive Branch Position Established		Implementation Phase	
	Inter-agency task group led by	(Target) or actual date of task group report	Agency/industry comments due or under review	Date referred to OFPP for decision	(Target) or actual date	Recommendation adopted, modified, or rejected	Legislation If Applicable: Bill or law	Date introduced or enacted
PART D--ACQUISITION OF COMMERCIAL PRODUCTS: (continued)								
3. Reevaluate commercial-type product specifications every 5 years, limit new Federal specifications for commercial-type products to those specifically justifiable, and use purchase descriptions if Federal specifications are unavailable (p. 18)	GSA	Sept. 1973			Feb. 1974	Modified		
4. Assign policy responsibility to OFPP for developing and coordinating Federal specifications (p. 18)	GSA	Dec. 1973			Dec. 1974	Adopted		
Acquisition of commercial products:								
5. Encourage use of headquarters procurement staff to train field procurement personnel on the job in implementing techniques and and identifying innovations related to their needs (p. 30)	GSA	Dec. 1973			May 1974	Adopted		

Implementation Phase — Executive Branch Action: Type	(Target) or actual completion date	GAO Comments on Responsiveness of Executive Branch Actions
		Legend: [R] Position fully responsive; [I] Position not yet established. Special Management Attention Needed: [PR] Position partially responsive; [NR] Position nonresponsive; [X] Position established, evaluation deferred in view of proposed implementation; [IX] Position not yet established
FMC	(Mar. 1975)	[R] Executive branch position and planned implementation action broadens the scope of the recommendation by (1) changing "Federal specifications" to "purchase specifications" so as to include Federal, military, and all other specifications developed by Federal agencies and (2) deleting specific references to the use of purchase descriptions in the absence of available Federal specifications, as being criteria of very limited scope and already comprehended within the proposed meaning of "purchase specifications." Implementation is to be accomplished through issuing an FMC instead of the FPMR that was initially proposed. The change was desired by OFPP which, under D-4 below, assumes a Government-wide policy responsibility for developing and coordinating all Federal specifications. The FMC is being processed by GSA's Office of Property Management which, in drafting the circular, is giving consideration to GAO's comments in its July 1974 report concerning the need for definitions of "purchase criteria", "purchase description", and "purchase specification", as well as a more detailed treatment of specification requirements for packing, packaging, and marking. Issuance of the circular is targeted for March 1975.
See comments		[R] Task group adopted the recommendation except for substitution of "purchase specifications" for "Federal specifications." DOD's official view differed with that of the task group. DOD proposed that policy responsibility for military specifications be retained in DOD and only that relating to Federal specifications for commercial products be centralized, preferably in a more engineering-oriented activity than OFPP, although DOD would not object to OFPP. The other executive agencies supported adoption of the recommendation and centralization of specification policy development and coordination responsibility, preferably in OFPP. In June 1974, on the advice of the interagency policy group, GSA referred the recommendation to OMB (before OFPP established) to resolve the conflicting views. In December 1974, OFPP informally decided to adopt the task group's recommendation as the executive branch position. Implementation will be accomplished through coordinated regulatory amendments, the FMC, or other media, as appropriate. GSA advised that an appropriate notice announcing acceptance of this recommendation is to be published in the Federal Register.
FMC	Aug. 1974	[R] FMC 74-6, issued in August 1974, makes the heads of agencies with decentralized procurement activities responsible for establishing and furnishing to GSA, within 180 days from the date of the circular, a continuing program aimed at removing impediments to improved operational effectiveness of these activities. The effective implementation of the recommendation will depend, in part, on the extent to which the individual programs to be submitted by the agencies early in 1975 are reviewed, evaluated, and monitored by GSA as agent for OFPP.

EXECUTIVE BRANCH POSITIONS AND IMPLEMENTING ACTIONS ON COMMISSION RECOMMENDATIONS AS OF JANUARY 1, 1975

Recommendation (GAO prepared these short-form statements of Commission recommendations. See indicated pages of Commission report for full texts)	Executive Branch Position in Process: Inter-agency task group led by	(Target) or actual date of task group report	Agency/industry comments due or under review	Date referred to OFPP for decision	Executive Branch Position Established: (Target) or actual date	Recommendation adopted, modified, or rejected	Implementation Phase, Legislation If Applicable: Bill or law	Date introduced or enacted
PART D--ACQUISITION OF COMMERCIAL PRODUCTS: (continued)								
6. Authorize OFPP by statute to establish, on a total economic cost basis, policies and standards for (1) procuring, storing, and distributing commercial products, (2) direct local source buys when consistent with centralized procurement requirements, (3) industrial funding, when practical, of interagency commercial product support activities, and (4) continuous evaluation of agency procurement and distribution systems (p. 32)	GSA	June 1974		Nov. 1974	(June 1975)			

Implementation Phase	GAO Comments on Responsiveness of Executive Branch Actions
Executive Branch Action Type (Target) or actual comple-tion date	Legend [R] Position fully responsive [I] Position not yet established Special Management Attention Needed [PR] Position partially responsive [NR] Position nonresponsive [X] Position established, evaluation deferred in view of proposed implementation [IX] Position not yet established

[IX] Interagency task group consisted of three major agencies operating interagency support activities--DOD, GSA, and VA. GSA and VA, as did consensus of official agency comments received on task group report, supported adoption of the recommendation.

However, DOD did not concur with the implementation proposed by GSA and VA. DOD asserted that it agreed with the intent of the recommendation, interpreting it to mean the achievement of greater economy in the procurement, storage, and distribution of commercial products. But, DOD in effect was rejecting its adoption by strongly opposing two essential parts--use of industrial funding and employment of standards to permit local using installations to buy directly from commercial sources at lower total economic costs. DOD contended that industrial funding is a costly and unsatisfactory accounting method for DSA items. DOD, as a principal GSA customer, also opposed its use by GSA, reluctantly agreeing to such use only if additional costs assessed, such as storage and distribution, came out of GSA appropriations, and DOD were granted full freedom to use alternate sources of supply when they were determined to be more economical, efficient, and effective. DOD further contended that there was no feasible or practical way to establish local purchase standards which could be applied equally to DOD and civilian agency activities because of DOD's unique mission requirements. The DOD supply system is a centralized system oriented to military support under emergency as well as peacetime conditions and is responsive to such requirements as mobilization planning and military readiness. DOD also believed that establishment of local purchase standards would increase its cost of supply support by creating an overlap of supply between local and central buying activities.

GSA believes the thrust of the recommendation could be achieved by DSA through some means other than industrial funding, such as the use of a total, economic cost basis. At a meeting of the interagency policy group in November 1974, DOD reiterated its opposition to the implementation of D-6 as proposed by GSA and VA. It again contended that use of industrial funding in DOD is impractical because it applies peacetime techniques to wartime needs of defense. As the differences between GSA and DOD could not be resolved, the recommendation was subsequently referred to OFPP for decision.

In June 1974, GSA submitted an enabling legislative proposal to OMB to implement the industrial funding aspects with respect to GSA. OFPP officials advised GAO that processing of enabling legislation will depend on how the differences are resolved and that this will take time. In a December 1974 report (PSAD-75-32)--Management of Federal Supply Service Procurement Programs Can Be Improved--GAO advised the Congress that it favored enactment of this legislation and that timely passage "will provide GSA with the incentive to retain centralized procurement of items that will result in savings to the Government and eliminate centralized procurement of items which agencies can procure more economically from commercial distribution systems." In consonance with the Commission's determinations, GAO further recommended that the GSA Administrator "develop cost data or pricing systems that will permit evaluation of total economic costs to the Government of supplying items through GSA channels for comparison with direct commercial procurement by agencies." GAO believes such data is essential to making informed procurement decisions.

The target date for an executive branch position is June 1975. Because of the conceptual interrelationship of D-6 and D-7, GAO believes that it's comments on D-7 below, on which an executive branch position has been established, should be considered by OFPP, as most of them have equal applicability to D-6. Further, in making its decision, GAO believes OFPP should inquire whether DOD's position evidences a desire to neither disclose DSA costs publicly nor compete with commercial distribution systems.

EXECUTIVE BRANCH POSITIONS AND IMPLEMENTING ACTIONS ON COMMISSION RECOMMENDATIONS AS OF JANUARY 1, 1975

	Executive Branch Position in Process				Executive Branch Position Established		Implementation Phase	
							Legislation If Applicable	
Recommendation (GAO prepared these short-form statements of Commission recommendations. See indicated pages of Commission report for full texts)	Inter-agency task group led by	(Target) or actual date of task group report	Agency/ industry comments due or under review	Date referred to OFPP for decision	(Target) or actual date	Recommendation adopted, modified, or rejected	Bill or law	Date introduced or enacted
PART D--ACQUISITION OF COMMERCIAL PRODUCTS: (continued)								
7. Require that consideration be given to direct procurement of U.S.-made commercial products from sources available to overseas activities when such sources are cost-effective (p. 38)	DOD	Dec. 1973			May 1974	Modified		

Implementation Phase Executive Branch Action Type (Target) or actual comple-tion date	GAO Comments on Responsiveness of Executive Branch Actions
	Legend [R] Position fully responsive [I] Position not yet established Special Management Attention needed [PR] Position partially responsive [NR] Position nonresponsive [X] Position established, evaluation deferred in view of proposed implementation [IX] Position not yet established

None contemplated [NR] Task group proposed adoption of the recommendation with the modification that overseas procurements be limited to items designated for decentralized management in the supply system. It was the view of the task group that (1) the present national supply system largely satisfies the thrust of the recommendation and (2) limiting procurement actions to decentralized items preserved the integrity of an effective and economical system responsive to wartime as well as peacetime logistic demands. As announced in the Federal Register, the executive branch adopted the task group's position and, as it is considered to be already a part of the supply/procurement regulations and operating practice, no implementing action was believed necessary.

GAO believes the executive branch action nonresponsive because:

(1) Limiting the recommendation to decentralized management items was only a continuation of existing operating practice, so the executive branch was actually rejecting the recommendation rather than accepting it in modified form, and the announcement in the Federal Register should have so stated with appropriate justification.

(2) The so-called modification in effect rejected consideration of cost-effectiveness and the potential for improving logistics support of activities operating overseas, both of which were inherent in the Commission's conclusions that:

> "Purchase of U.S.-made commercial products by overseas activities from U.S. firms or subsidiaries with overseas distribution systems provide a potential for savings over shipment of these items by the U.S. Government from the United States."
>
> * * * * *
>
> "Indefinite delivery contracts can be used to simplify procurement of U.S.-made products from overseas sources."
>
> * * * * *
>
> "Overseas activities should not be required to order material from the United States without consideration of alternatives that may be more cost-effective."

(3) D-7 and D-6 are conceptually interrelated, in that D-6 calls for the establishment of Government-wide procurement policies and standards on a total economic cost basis, so the executive branch was premature in formulating a position on subsidiary recommendation D-7, that was agreeable to DOD, before establishing an executive branch position on primary recommendation D-6.

GAO believes OFPP should reconsider D-7 consistent with its ultimate action on D-6. In this respect, a number of questions arise that merit attention.

(a) Do our commercial distribution systems and inventories represent a national asset which can be called upon through contractual arrangements or mobilized in emergency, when necessary, to fulfill our defense needs more responsively than if we stocked and distributed such readily available commercial items in a Government centralized supply system?

(b) Should the central supply system be limited to spare parts, ordnance, and other items, necessary to support weapons systems and military operations, that are not readily available in commercial distribution systems and that would, therefore, be costly and time consuming to reproduce?

EXECUTIVE BRANCH POSITIONS AND IMPLEMENTING ACTIONS ON COMMISSION RECOMMENDATIONS AS OF JANUARY 1, 1975

Recommendation (GAO prepared these short-form statements of Commission recommendations. See indicated pages of Commission report for full texts)	Executive Branch Position in Process				Executive Branch Position Established		Implementation Phase Legislation If Applicable	
	Inter-agency task group led by	(Target) or actual date of task group report	Agency/industry comments due or under review	Date referred to OFPP for decision	(Target) or actual date	Recommendation adopted, modified, or rejected	Bill or law	Date introduced or enacted
PART D--ACQUISITION OF COMMERCIAL PRODUCTS: (continued)								
8. Authorize primary grantees the option to use Federal sources of supply to support more than 60-percent federally financed programs, provided Government is fully reimbursed for such use (with dissent) (p. 39)	GSA	Mar. 1974			May 1974	Rejected		
9. Require grantor agency to have procedures for insuring appropriate use of Federal supplies and computing total costs for Government reimbursement (with dissent) (p. 39)	GSA	Mar. 1974			May 1974	Rejected		
10. Assign OFPP to monitor implementation of recommendations D-8 and D-9 (p. 39)	GSA	Mar. 1974			May 1974	Rejected		

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Implementation Phase		
Executive Branch Action		GAO Comments on Responsiveness of Executive Branch Actions
Type	(Target) or actual completion date	

L e g e n d

[R] Position fully responsive
[I] Position not yet established

Special Management Attention Needed
[PR] Position partially responsive
[NR] Position nonresponsive
[X] Position established, evaluation deferred in view of proposed implementation
[IX] Position not yet established

(c) Is DSA's position on D-7 consistent with the views of the military services, including field-level support activities responsible for maintaining the necessary mission support readiness posture?
(d) Does a centralized supply system for readily available commercial products, and the standardization that it entails, result in use of specifications that preclude buying the latest available products, discourage industry innovation, restrain competition, cause the Government to buy in excess of minimum need in order to satisfy all users and, as pointed out in the Commission report, result in substantial obsolescence and unused inventory (note a)?
(e) Can cost visibility for making decisions on alternative methods of support be achieved by interagency support activities without a full cost-recovery system?
(f) Shouldn't even greater latitude be allowed to agencies operating overseas to procure locally due to transportation costs and delivery time?
(g) Is the concept of mandatory use of centrally stocked items by all users without regard for cost-effectiveness and responsiveness valid for commercially available items?

[R] Late in 1972 the executive branch terminated grantee use of Federal sources of supply due to widespread objections by small business concerns. As publicized in the Federal Register of May 10, 1974, the executive branch rejected recommendations D-8, D-9, and D-10 because it believed that neither the Commission, which was divided on the recommendations, nor the task group introduced new evidence to justify reinstating the use of Federal sources of supply by grantees. Both the House and Senate bills involved in the enactment of Public Law 93-400 to establish OFPP, were modified to accomodate views of small business against giving OFPP authority to authorize the use of Federal sources of supply by grantees. In reporting on the law, the Congress specified that nothing in the law was to be construed as giving OFPP any such authority.

[R] See D-8 comments

[R] See D-8 comments

[a] Attention is directed to a 1975 GAO report (LDC-74-430) suggesting that the Congress question DOD about the rationale for continued adherence to rigid food specifications inasmuch as the inability of DOD's central food purchasing agency to depart quickly from such specifications resulted not only in higher costs but also in a lack of responsiveness to solicitations for bids and, quite frequently, in shortages of required food items.

EXECUTIVE BRANCH POSITIONS AND IMPLEMENTING ACTIONS ON COMMISSION RECOMMENDATIONS AS OF JANUARY 1, 1975

Recommendation (GAO prepared these short-form statements of Commission recommendations. See indicated pages of Commission report for full texts)	Executive Branch Position in Process				Executive Branch Position Established		Implementation Phase	
	Inter-agency task group led by	(Target) or actual date of task group report	Agency/industry comments due or under review	Date referred to OFPP for decision	(Target) or actual date	Recommendation adopted, modified, or rejected	Legislation If Applicable: Bill or law	Date introduced or enacted
PART D--ACQUISITION OF COMMERCIAL PRODUCTS: (continued)								
Special products and services:								
11. Reevaluate ADPE acquisition procedures in light of total economic cost (p. 46)	GSA	June 1974			July 1974	Adopted		
12. Require GSA to establish ADPE procurement delegation policy to promote effective preplanning of agency requirements and optimum use of manpower (p. 48)	GSA	Dec. 1973	X		(June 1975)			

Implementation Phase — Executive Branch Action: Type	(Target) or actual completion date	GAO Comments on Responsiveness of Executive Branch Actions
		Legend
		[R] Position fully responsive
		[I] Position not yet established
		Special Management Attention Needed
		[PR] Position partially responsive
		[NR] Position nonresponsive
		[X] Position established, evaluation deferred in view of proposed implementation
		[IX] Position not yet established

See comments

[R] At an interagency policy group meeting in July 1974, the Commission recommendation to use the total economic cost concept in ADPE acquisitions was accepted as the executive branch position. Implementation is to be performed as an extension of a current contractual ADP acquisition strategy study being made by GSA's ADP Management Division. Upon completion of the study, targeted for January 1975, implementation work on D-11 will begin. Completion of the required ADPE acquisition procedures reevaluation is estimated to take 6 months to 1 year. A target completion date for implementation has not been established.

[IX] Task group unanimously adopted Commission recommendation and developed a proposed revision to existing Federal Property Management Regulation (FPMR) for automated data telecommunications systems (ADTS) plans as a device to expedite implementation. The views of 19 of the 21 agencies solicited agreed with the task group position.

The FPMR revision was officially published in the Federal Register in May 1974 as FPMR 101-32.15. The revision requires agencies to submit annually, to GSA, major ADP system requirements plans for each of 5 succeeding fiscal years. A major system is defined as including one for which total planned expenditure in any fiscal year for hardware, software, personnel engaged in system development, and related items exceeds $1 million. The revision was intended to apply only to future planning to enable GSA to determine potential requirements for multiuser computers or communication facilities and to allow advance notification of procurements that GSA will assume and those it will delegate to agencies. Another FPMR revision is under consideration that would require GSA, within 30 days after receipt of an agency's ADTS plan, to notify the agency concerning procurements scheduled for RFP release in the upcoming fiscal year.

At a meeting of the interagency policy group in October 1974, the DOD representative contended that the May 1974 FPMR revision--Future Plans for ADP and Telecommunications Systems--was not responsive to the intent of D-12 and had not implemented it. DOD's position was that the FPMR did not provide a realistic dollar threshold for delegations under which agencies might procure ADP requirements without prior GSA approval. The GSA Office of Federal Management Policy took the matter under advisement for further review and discussion with its ADP Management and Automated Data Telecommunications Systems Divisions.

In December the ADP Management Division reported that OMB and GSA financial and narrative planning reporting requirements are presently under review in an effort to eliminate duplication and to improve the utility of the reports for ADP planning. The review includes the reporting requirements under FPMR 101-32.15. Until the review is completed, the Management Division believes it is premature to conclude that D-12 has been implemented by the FPMR, since there may evolve from the review a consolidated financial and narrative reporting system that will reduce the agency reporting burden and better implement D-12 objectives.

Establishment of an executive branch position is targeted for June 1975.

EXECUTIVE BRANCH POSITIONS AND IMPLEMENTING ACTIONS ON COMMISSION RECOMMENDATIONS AS OF JANUARY 1, 1975

Recommendation (GAO prepared these short-form statements of Commission recommendations. See indicated pages of Commission report for full texts)	Executive Branch Position in Process				Executive Branch Position Established		Implementation Phase Legislation If Applicable	
	Inter-agency task group led by	(Target) or actual date of task group report	Agency/industry comments due or under review	Date referred to OFPP for decision	(Target) or actual date	Recommendation adopted, modified, or rejected	Bill or law	Date introduced or enacted
PART D--ACQUISITION OF COMMERCIAL PRODUCTS: (continued)								
13. Revise funding policies for multiyear leasing to permit ADPE procurement on a cost-effective basis in addition to use of ADPE fund (p. 48)	GSA	Dec. 1973			Sept. 1974	Modified	S. 2785	Dec. 1973
14. Develop standard benchmarks to be used in evaluating ADPE proposals (p. 51)	GSA	Mar. 1974			May 1974	Adopted		
15. Conform ADPE late-proposal clause with other procurement practices (p. 51)	GSA	Oct. 1973			Sept. 1973	Adopted		

Implementation Phase			GAO Comments on Responsiveness of Executive Branch Actions
Executive Branch Action			Legend
Type	(Target) or actual comple-tion date		[R] Position fully responsive [I] Position not yet established Special Management Attention Needed [PR] Position partially responsive [NR] Position nonresponsive [X] Position established, evaluation deferred in view of proposed implementation [IX] Position not yet established
		[R]	Task group's majority position and consensus of solicited agency views favored adoption of the Commission recommendation. However, GSA would not accept this position on the ground that it was inconsistent with the concept of a single manager of Government ADP equipment as well as the appropriate use of the ADPE fund. GSA believes that ADPE procurements by any agency should be financed only from the ADP fund and that implementation of the recommendation can best be achieved through enactment of S. 2785. This bill would authorize GSA to enter into firm-term, multiyear leases through the use of ADP fund without obligating the full amount of the multiyear contract at the outset. In July 1974, at the suggestion of the interagency policy group, the conflicting positions of GSA and the agencies were referred to OMB (before OFPP established) for evaluation and decision. OMB decided against the majority and officially adopted GSA's position, with implementation through the enactment of S.2785. This bill was passed by the Senate in September 1974 and sent to the House, but insufficient time remained in the 93d Congress for House action. GSA's 1975 legislative program for the first session of the 94th Congress indicates that resubmission of an implementing legislative proposal is planned.
See comments	(2-5 years)	[X]	Executive branch considers that the thrust of this recommendation has been adopted and implementation begun in view of two ongoing benchmark feasibility studies presently being made by DOD and the NBS Institute for Computer Science and Technology (NBS/ICST). The executive branch position has been made known to NBS/ICST and published in the Federal Register. Full implementation will be contingent on the results of these studies, which will take an estimated 2 to 5 years to complete, based on current resources. A time frame of from 2 to 5 years to complete these studies seems to reflect an unreasonably low priority assignment to the task. GAO believes the executive branch should improve on its target completion date for implementing this recommendation.
ASPR FPR FPMR	May 1973 Sept. 1973 Dec. 1973	[R]	Recommendation adopted by executive branch in September 1973 and implemented by issuance of an appropriate FPR in the same month and an FPMR in the following December. ASPR had been amended in May 1973.

EXECUTIVE BRANCH POSITIONS AND IMPLEMENTING ACTIONS ON COMMISSION RECOMMENDATIONS AS OF JANUARY 1, 1975

Recommendation (GAO prepared these short-form statements of Commission recommendations. See indicated pages of Commission report for full texts)	Executive Branch Position in Process				Executive Branch Position Established		Implementation Phase Legislation If Applicable	
	Interagency task group led by	(Target) or actual date of task group report	Agency/industry comments due or under review	Date referred to OFPP for decision	(Target) or actual date	Recommendation adopted, modified, or rejected	Bill or law	Date introduced or enacted
PART D--ACQUISITION OF COMMERCIAL PRODUCTS: (continued)								
16. Assign to OFPP or other Presidential-designated agency the responsibility for consistently and equitably implementing the legislative food-acquisition policy (p. 54)	USDA	Mar. 1974		Sept. 1974	(June 1975)			

Implementation Phase		GAO Comments on Responsiveness of Executive Branch Actions	
Executive Branch Action		Legend	
Type	(Target) or actual comple-tion date	[R] Position fully responsive [I] Position not yet established	Special Management Attention Needed [PR] Position partially responsive [NR] Position nonresponsive [X] Position established, evaluation deferred in view of proposed implementation [IX] Position not yet established

[IX] Task group recommended adoption of Commission recommendations D-16 and D-17 and official agency comments were solicited from five agencies in June 1974. The agencies were asked to consider two questions: (1) Whether implementation of the food acquisition policy (D-16) and the food-quality assurance program (D-17) should be handled by separate organizations, OFPP, or a Presidential-designated agency and (2) whether D-17 should be broadened by substitution of a "central director", as recommended by the task group, in lieu of a "central coordinator", as recommended by the Commission. A staff analysis of agency responses shows that HEW, VA, and GSA supported the task group approach of a central director. The two major food acquisition departments, Agriculture and DOD, do not favor separate identification of food acquisition policy and food-quality assurance in OFPP. DOD opposed establishment of a food acquisition policy group in OFPP because policy implementation would be only one of OFPP's responsibilities, and such a group would interfere with the flexibility OFPP should have to discharge all of its responsibilities, particularly in view of staffing and budgetary limitations. DOD did not concur with the legislative requirement in recommendation D-17 on the ground that the necessary authority to coordinate the Federal food-quality assurance program is already an inherent part of OFPP's mission. Agriculture did not concur with either recommendation in the belief that coordination of Federal food procurement policies can be achieved within the framework of existing agencies so that an additional layer of Government is unnecessary. It pointed out that more than 96 percent of Federal food procurement involves only Agriculture and DOD, which have substantial food procurement expertise.

At a meeting of the interagency policy group in August 1974, it was decided to refer these recommendations to OMB (before OFPP established) for disposition. OMB believes that implementation of D-16 and D-17 can be accomplished without additional legislation. The problem is how to go about doing it. OMB believes that, most likely, it will be accomplished through an interagency group headed by Agriculture and that the needed legislative authority to implement D-17 is in the statute that created OFPP. Further executive branch action has been deferred until OFPP becomes operational.

GAO believes that a central food acquisition policymaking body could not function effectively as a separate entity outside OFPP, because its policies and guidelines would be advisory rather than mandatory and each agency would continue its own policies and guidelines. GAO also believes that whoever is assigned management responsibility for a Federal food-quality assurance program--whether he be labeled coordinator or director--must have authority to see that established policies are carried out. Otherwise, the agencies will continue their own independent ways as they are now doing. In January 1975, GAO reported to the Congress that the methods used by DOD in purchasing food for the military services are costly and inefficient. (See reference to this report in footnote to D-7)

EXECUTIVE BRANCH POSITIONS AND IMPLEMENTING ACTIONS ON COMMISSION RECOMMENDATIONS AS OF JANUARY 1, 1975

Recommendation (GSA prepared these short-form statements of Commission recommendations. See indicated pages of Commission report for full texts)	Executive Branch Position in Process: Inter-agency task group led by	(Target) or actual date of task group report	Agency industry comments due or under review	Date referred to OFPP for decision	Executive Branch Position Established: (Target) or actual date	Recommendation adopted, modified, or rejected	Implementation Phase, Legislation If Applicable: Bill or law	Date introduced or enacted
PART D--ACQUISITION OF COMMERCIAL PRODUCTS: (continued)								
17. Establish by law a central coordinator of agency management responsibilities for Federal food-quality assurance program (p. 54)	USDA	May 1974		Sept. 1974	(June 1975)			
18. Encourage acceptance of commercial provisions and forms used for industry and public in agency procurement of utility supplies and services (p. 61)	GSA	Mar. 1974			Nov. 1974	Adopted		
19. Determine whether more innovative transportation procurement techniques are warranted when alternative sources and modes are available (p. 61)	GSA	Dec. 1973			May 1974	Adopted		

Implementation Phase Executive Branch Action Type (Target) or actual completion date	GAO Comments on Responsiveness of Executive Branch Actions Legend [R] Position fully responsive [I] Position not yet established Special Management Attention Needed [PR] Position partially responsive [NR] Position nonresponsive [X] Position established, evaluation deferred in view of proposed implementation [IX] Position not yet established
	[IX] See D-16 comments
FPR/ASPR (June 1975)	[X] Task group proposed adoption of this recommendation for the Government to follow commercial practice in procuring utility supplies and services. The consensus of the 19 agencies solicited for official comment concurred with the task group. At the meeting of the interagency policy group in November 1974, the task group position was accepted as the executive branch position, with necessary implementation guidelines to be developed jointly by the FPR staff and ASPR committee. In November, the FPR Director and the ASPR Chairman were requested by the GSA Office of Procurement Management to establish such a joint project to review implementation issues raised by agencies' official comments and to develop appropriate FPR and ASPR amendments to effect implementation. With respect to implementation, GAO and GSA both recognize that one problem to be resolved involves an interpretation of what the Commission intended in making the recommendation. The task group report stated that five different interpretations could be made, but made no attempt to establish the one that would be most appropriate. GAO believes the task group should have done additional research work to resolve these varying interpretations. The executive branch has agreed to adopt the recommendation, but it is not clear at this time what interpretation will be selected or what implementation action will be taken.
See comments	[X] Executive branch, as stated in our last report, has adopted this recommendation, but the task group takes the position that implementation is being effected through continuing ongoing efforts to implement Joint Agency Transportation Study (JATS) recommendations and through continuing examination of techniques to generate more competition in the procurement process. GAO believes that simple adoption of the JATS recommendations will not achieve what the Commission desired; namely, greater consideration of competitive transportation sources and modes. Executive branch is in accord with this belief as evidenced by instructions to the task group in May 1974 to submit a supplemental report dealing specifically with procurement aspects of obtaining competition for transportation services, including findings, analyses, and conclusions on competitive techniques and ongoing efforts to improve them. In July 1974 the task group submitted a supplemental section to its report. After evaluation, GSA's Office of Procurement Management sent a September 1974 memorandum to GSA's Federal Supply Service, the activity responsible for the report, questioning the completeness of the supplemental information in a number of of areas. The memorandum requested the task group to revise or resubmit its supplemental report so that it contained sufficient information to answer both GAO report comments in July 1974 and GSA questions on its supplemental submission. At an October 1974 meeting held by GSA Office of Procurement Management officials, Federal Supply Service personnel, and the Transportation Commissioner, agreement was reached as to what the supplemental submission should contain to support the executive branch position that D-19 is being implemented and that greater consideration is being given to competitive transportation sources and modes. The supplemental submission is targeted for some time in January 1975.

EXECUTIVE BRANCH POSITIONS AND IMPLEMENTING ACTIONS ON COMMISSION RECOMMENDATIONS AS OF JANUARY 1, 1975

Recommendation (GAO prepared these short-form statements of Commission recommendations. See indicated pages of Commission report for full texts)	Executive Branch Position in Process				Executive Branch Position Established		Implementation Phase: Legislation If Applicable	
	Inter-agency task group led by	(Target) or actual date of task group report	Agency industry comments due or under review	Date referred to OFPP for decision	(Target) or actual date	Recommendation adopted, modified, or rejected	Bill or law	Date introduced or enacted
PART E--ACQUISITION OF CONSTRUCTION AND ARCHITECT AND ENGINEERING SERVICES:								
1. Procure architect-engineer services through competitive negotiations, with selection based primarily on technical competence and merits of end products, including cost--fee should not be a dominant factor (with dissent) (p. 115)	GSA	Dec. 1973	X		(Mar. 1975		H.R. 9061	June 1973

Implementation Phase Executive Branch Action Type (Target) or actual comple- tion date	GAO Comments on Responsiveness of Executive Branch Actions	
	Legend	Special Management Attention needed
	[R] Position fully responsive	[PR] Position partially responsive
	[I] Position not yet established	[NR] Position nonresponsive
		[X] Position established, evaluation deferred in view of proposed implementation
		[IX] Position not yet established

[IX] Task group's report concurs in the Commission's minority position on recommendations E-1 thru E-3 which represents the views of the profession and Federal construction agencies. In concurring, the task group recommended that "the procurement of A-E services should continue to be based upon a competitive selection process as outlined in Public Law 92-582 and the Armed Services Procurement Regulation, which focus upon the technical competence and record of performance of interested firms." Although nothing new was offered in support of the Commission's minority position, a GSA staff analysis of official agency views indicates that GSA, DOD, and a substantial number of other agencies solicited, concurred with the task group. However, there were several agencies, including OMB, that supported the Commission's majority position--and two agencies that favored a compromise.

In June 1974, after soliciting official agency views, the GSA Administrator accepted a report from GSA's "Special Study Committee on the Selection of Architects and Engineers." The Administrator announced that, in addition to the Committee's recommended changes, he had decided upon a plan to be implemented over a 3 to 5 year period with a modest first step to be taken in January 1975. The plan ultimately will require GSA to award A-E contracts on the basis of fully developed "project proposals" that will include "evidence of technical and professional distinction; estimated fees; construction and life cycle cost estimates; and planning and design concepts." The Administrator stated that his decision responds to "GSA's concern for the production of the finest architecture" and "to realities of the construction industry."

According to a GSA position paper on the selection of A-Es through "project proposals" that was approved in November 1974, "instead of depending exclusively on an evaluation of professional competence and reputation, future commissions [contract awards] will include professional competition based on technical proposals as a means to encourage new thinking, new solutions, and accelerate the move of the construction industry into the twentieth century." The "project proposal" is intended to be "the medium through which interested qualified architects and engineers will compete for selection on our projects." Professional competition would be conducted through four broadly defined categories and a matrix approach would be used in developing criteria for selecting of A-Es at various competitive levels, depending on the size and complexity of the program. Price or fee, being a controversial element in the proposed professional competition concept, would be the last factor introduced into the project proposal matrix.

Implementation of the project proposal concept would be accomplished through (1) establishing a GSA Steering Committee with working subcommittees to develop the detail criteria under committee guidelines; (2) a conference sponsored by the Committee on Federal Procurement of A-E services, composed of interested industry associations, to provide a forum for announcing details of the concept; and (3) a testing program developed and implemented by GSA's Office of Construction Management with private sector participation in the evaluation phase.

At a meeting of the interagency policy group in December 1974, the GSA Office of Procurement Management recommended adopting E-1 through E-3 with implementation to be accomplished generally along the lines of the proposed "project proposal" concept. However, because of DOD's continued objection to adopt this as the executive branch position, it was decided to return the three recommendations to the task group to reconsider the alternative position embodied in the GSA Administrator's project proposal.

GAO believes that the proposed concept and implementation represents progress toward accomplishing the Commission's majority recommendations and is consistent with the intent and purpose of H.R. 9061 which was introduced in June 1973 and referred to the Judiciary Committee. In December 1974, OMB provided to the committee an executive branch position that supported the provision in the bill for competitive negotiation of A-E services.

EXECUTIVE BRANCH POSITIONS AND IMPLEMENTING ACTIONS ON COMMISSION RECOMMENDATIONS AS OF JANUARY 1, 1975

Recommendation (GAO prepared these short-form statements of Commission recommendations. See indicated pages of Commission report for full texts)	Executive Branch Position in Process: Inter-agency task group led by	(Target) or actual date of task group report	Agency/industry comments due or under review	Date referred to OFPP for decision	Executive Branch Position Established: (Target) or actual date	Recommendation adopted, modified, or rejected	Implementation Phase, Legislation If Applicable: Bill or law	Date introduced or enacted
PART E--ACQUISITION OF CONSTRUCTION AND ARCHITECT AND ENGINEERING SERVICES: (continued)								
2. Provide policy guidance through OFPP for including estimated total life-cycle costs in architect-engineer proposals on projects estimated to cost more than $500,000 when realistic estimates are feasible (with dissent) (p. 115)	GSA	Dec. 1973			(Mar. 1975)			
3. Consider reimbursing proposal submission costs to architect-engineer when unusual design and engineering problems and substantial work efforts are required (p. 115)	GSA	Dec. 1973			(Mar. 1975)			
4. Repeal statutory architect-engineer fee limit and authorize OFPP policy guidelines to insure consistency and to protect Government interest (p. 122)	GSA	Dec. 1973			July 1974	Adopted	H.R. 9061	June 1973

Implementation Phase		GAO Comments on Responsiveness of Executive Branch Actions
Executive Branch Action		Legend
Type	(Target) or actual comple-tion date	[R] Position fully responsive [I] Position not yet established Special Management Attention Needed [PR] Position partially responsive [NR] Position nonresponsive [X] Position established, evaluation deferred in view of proposed implementation [IX] Position not yet established

[IX] It is to be noted that adoption of this recommendation by the executive branch would be consistent with a December 1974 decision of the U.S. District Court for the District of Columbia. In an action brought by the Government against the National Society of Professional Engineers, the Court ruled that certain provisions of the society's code of ethics, in prohibiting its members from submitting competitive bids for their engineering services, are a per se violation of the federal anti-trust statutory prohibitions against price fixing. The society plans to carry its appeal to the U.S. Supreme Court.

[IX] See E-1 comments

[IX] See E-1 comments

See comments [X] The interagency policy group at a meeting in July 1974 concurred in executive branch adoption of E-4. It was decided that the best course of action to accomplish implementation would be to submit separate legislation repealing five statutory provisions that limit A-E fees and cause confusion in both Government and industry. Notice of adoption was published in the Federal Register on August 5, 1974. A legislative proposal is to be drafted by GSA and will be processed through OFPP. FPR and ASPR staffs in a coordinated effort are developing policy guidelines to be promulgated by OFPP to insure consistency of action. In its July 1974 report, GAO pointed out that retaining of the fee limitation in regulations, as proposed in the task group report, in effect would preserve the present outdated legal requirement and defeat the Commission recommendation. In response, OMB said the GAO comments will be considered in developing the policy guidelines.

In December 1974, GSA informed GAO that submission of the legislative proposal to OFPP is being deferred pending disposition of recommendations E-1 thru E-3 above since their adoption, as proposed, would provide the assurance needed by Congress that competitive restraints would operate in place of a statutory fee ceiling.

EXECUTIVE BRANCH POSITIONS AND IMPLEMENTING ACTIONS ON COMMISSION RECOMMENDATIONS AS OF JANUARY 1, 1975

Recommendation (GAO prepared these short-form statements of Commission recommendations. See indicated pages of Commission report for full texts)	Executive Branch Position in Process				Executive Branch Position Established		Implementation Phase: Legislation If Applicable	
	Inter-agency task group led by	(Target) or actual date of task group report	Agency/industry comments due or under review	Date referred to OFPP for decision	(Target) or actual date	Recommendation adopted, modified, or rejected	Bill or law	Date introduced or enacted
PART F--FEDERAL GRANT-TYPE ASSISTANCE PROGRAMS:								
1. Distinguish through legislation the procurement (contract) and assistance (grant) relationships and authorize use of instruments reflecting these relationships (p. 162)	HEW	Sept. 1973	X				H.R. 9060 S.3514	June 1973 May 1974

Implementation Phase		GAO Comments on Responsiveness of Executive Branch Actions
Executive Branch Action		Legend
Type	(Target) or actual comple-tion date	[R] Position fully responsive [I] Position not yet established Special Management Attention Needed [PR] Position partially responsive [NR] Position nonresponsive [X] Position established, evaluation deferred in view of proposed implementation [IX] Position not yet established

[I] The task group proposed adopting F-1 as recommended by the Commission with the qualification that the contemplated distinction between "grant" and "grant-in-aid" be eliminated. It also proposed that implementation be accomplished by a marked-up version of H.R. 9060, then pending before a House subcommittee. Two major procuring agencies (DOD and NASA) disagreed with the majority position. They opposed labeling research grants as an "assistance" relationship. In May 1974, Senator Chiles, Roth, et al, introduced S. 3514, which included both the definitions for the use of contract and grant-type instruments and a requirement for the study called for in F-2 below. During Senate hearings on S. 3514, the executive branch agreed to work with the subcommittee in attempting to refine the definition terminology and iron out differences. GAO testified in favor of enacting legislation, because it constituted a significant step forward, and suggested the F-2 study be broadened to include a further review of the terminology for possible administrative or legislative refinement at a later date.

In October 1974, a revised version of S. 3514, which incorporated changes suggested by GSA, GAO and others, was passed by the Senate and sent to the House. In November 1974, the House Government Operations Committee held hearings on the revised Senate bill. GAO again supported its enactment contending the statutory definitions of "contract," "grant," and "cooperative agreement" had been sufficiently developed by the Commission to identify these broad categories for policymaking purposes and that the feasibility study could develop the guidelines and criteria for specific application. OMB testimony which followed took the position that more work is first needed on the definitions for use of contract and grant-type instruments. It said the executive branch is clearly interested in enacting legislation and establishing definitions. The only issue according to OMB is one of sequence. OMB believes the F-2 study should precede F-1 legislation and that legislation is not needed for the study, although it has no objection to such legislation.

In this respect, OMB testified that its staff has been working with GSA's Office of Federal Management Policy over the past few months to complete plans required for the feasibility study recommended in F-2. OMB stated that the review is to begin within the next few months and is scheduled for completion not later than December 31, 1975. It should be noted that during Senate hearings in June 1974, the executive branch testified it would proceed with a study similar to that contemplated by S. 3514 and that there was "no need for legislation simply to initiate a study already contemplated." Six months later, however, the overall study is not yet underway although a charter is now under review, initial preparations for the study are in process, and some guidelines in selected assistance areas have been developed. An official associated with these preparations advised that the first phase of the study called for by the charter involves procurement and assistance definitions and relationships. He believes this phase can be completed by December 31, 1975, but he doubts that the entire study can be completed by this date unless additional resources are made available.

EXECUTIVE BRANCH POSITIONS AND IMPLEMENTING ACTIONS ON COMMISSION RECOMMENDATIONS AS OF JANUARY 1, 1975

Recommendation (GAO prepared these short-form statements of Commission recommendations. See indicated pages of Commission report for full texts)	Executive Branch Position in Process: Inter-agency task group led by	Executive Branch Position in Process: (Target) or actual date of task group report	Executive Branch Position in Process: Agency/industry comments due or under review	Executive Branch Position in Process: Date referred to OFPP for decision	Executive Branch Position Established: (Target) or actual date	Executive Branch Position Established: Recommendation adopted, modified, or rejected	Implementation Phase — Legislation If Applicable: Bill or law	Implementation Phase — Legislation If Applicable: Date introduced or enacted
PART F--FEDERAL GRANT-TYPE ASSISTANCE PROGRAMS: (continued)								
2. Urge OFPP to undertake or sponsor a feasibility study on developing a system of guidance for Federal assistance programs (p. 168)	GSA	Mar. 1974			June 1974	Adopted	S.3514	May 1974

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Implementation Phase — Executive Branch Action: Type	(Target) or actual completion date	GAO Comments on Responsiveness of Executive Branch Actions
		Legend [R] Position fully responsive [I] Position not yet established Special Management Attention Needed [PR] Position partially responsive [NR] Position nonresponsive [X] Position established, evaluation deferred in view of proposed implementation [IX] Position not yet established
		[I] In GAO's July 1974 report, concern was expressed over the makeup of the study group and how a State or local government or other interested parties would be represented or otherwise have a voice in group deliberations. Concern was expressed also that the planned study would focus more on administrative requirements to be imposed on grantees than on the all-inclusive grant preaward, postaward policy guidance for executive agencies contemplated by the Commission recommendation. In addition, GAO pointed out that recognition should be given in the study to the need for the executive branch to assign a focal point of responsibility for monitoring and periodically updating the system of guidance once initially developed. As the 93d Congress did not enact legislation requiring the F-2 study before adjourning, it will have to be reintroduced in the 94th Congress. GAO believes such legislation is desirable to provide the needed visibility and the necessary resources to accomplish the study and to insure its completion by December 31, 1975.
Study	(Dec. 1975)	[X] See F-1 comments.

EXECUTIVE BRANCH POSITIONS AND IMPLEMENTING ACTIONS ON COMMISSION RECOMMENDATIONS AS OF JANUARY 1, 1975

Recommendation (GAO prepared these short-form statements of Commission recommendations. See indicated pages of Commission report for full texts)	Executive Branch Position in Process: Inter-agency task group led by	(Target) or actual date of task group report	Agency/industry comments due or under review	Date referred to OFPP for decision	Executive Branch Position Established: (Target) or actual date	Recommendation adopted, modified, or rejected	Implementation Phase Legislation If Applicable: Bill or law	Date introduced or enacted
PART G--LEGAL AND ADMINISTRATIVE REMEDIES:								
Disputes arising in contract performance:								
1. Clarify to contractor the identity and authority of contracting officer and other designated officials to act for Government in contract disputes (p. 12)	DOD	May 1974			Dec. 1974	Modified		

Implementation Phase — Executive Branch Action: Type	(Target) or actual completion date	GAO Comments on Responsiveness of Executive Branch Actions

Legend

[R] Position fully responsive
[I] Position not yet established

Special Management Attention Needed
[PR] Position partially responsive
[NR] Position nonresponsive
[X] Position established, evaluation deferred in view of proposed implementation
[IX] Position not yet established

General (G-1 through G-12)

Commission recommendation G-11 had already been placed into effect in 1972 as part of FPR and ASPR. GSA considered recommendations G-1 through G-10 and G-12 to be interrelated and handled them as a single package because all of them are concerned with a legal or administrative remedies system for resolving contract performance claims and disputes. In June 1974, the task group reports and GSA staff analyses were sent to the agencies for official comment. At the December 1974 meeting of the interagency policy group, it was decided to adopt G-5 as recommended by the Commission and also G-1 with some modification. Recommendations G-3, G-7, and G-8 require legislation and are being referred to OFPP with the recommendation that they be accepted through the legislative process. Recommendations G-2, G-4, G-6, G-9, G-10, and G-12 were rejected. Legislation had been introduced in the House during the 93d Congress in June 1973 (H.R. 9062) and in August 1974 (H.R. 16423) that would have implemented, in whole or in part, recommendations G-2 thru G-12, but no action was taken on these bills before adjournment. Individual comments regarding executive branch action on each of the recommendations follow.

Type	Date		Comments
FMC	(Aug. 1975)	[R]	The task group agreed with the general thrust of the recommendation to clarify to the contractor the identity and authority of the contracting officer but it objected to informing the contractor as to the identity and authority of "other designated officials" acting for the Government. The task group thought that such knowledge might encourage the contractor to deal with these other individuals instead of the contracting officer. The decision by the interagency policy group to adopt this recommendation was made with the proviso that the phrase "other designated officials" be clarified to include examples of such officials, such as, Contracting Officer's Representative, Administrative Contracting Officer, etc. Implementation is to be accomplished by issuing an FMC to be drafted by GSA and discussed with OFPP at a future interagency policy group meeting. An appropriate notice to this effect is being prepared for publication in the Federal Register. Issuance of the circular is targeted for August 1975.

EXECUTIVE BRANCH POSITIONS AND IMPLEMENTING ACTIONS ON COMMISSION RECOMMENDATIONS AS OF JANUARY 1, 1975

Recommendation (GAO prepared these short-form statements of Commission recommendations. See indicated pages of Commission report for full texts)	Executive Branch Position in Process: Inter-agency task group led by	(Target) or actual date of task group report	Agency/industry comments due or under review	Date referred to OFPP for decision	Executive Branch Position Established: (Target) or actual date	Recommendation adopted, modified, or rejected	Implementation Phase — Legislation If Applicable: Bill or law	Date introduced or enacted
PART G--LEGAL AND ADMINISTRATIVE REMEDIES: (continued)								
2. Provide informal review conference of adverse contracting officer decisions with contractor attendance mandatory when dispute exceeds $25,000 or contractor invokes recommendation G-6 below (p. 22)	DOD	May 1974			Dec. 1974	Rejected	H.R. 9062 H.R. 16423	June 1973 Aug. 1974
3. Retain multiagency appeals boards, establish minimum personnel and caseload standards, and add subpoena and discovery powers (p. 20)	DOD	May 1974		Jan. 1975	(Mar. 1975)		H.R. 9062 H.R. 16423	June 1973 Aug. 1974
4. Establish regional small claims boards for disputes of $25,000 or less (p. 22)	DOD	May 1974			Dec. 1974	Rejected	H.R. 9062 H.R. 16423 S.3610	June 1973 Aug. 1974 June 1974

Implementation Phase: Executive Branch Action — Type	(Target) or actual completion date	GAO Comments on Responsiveness of Executive Branch Actions
		Legend — [R] Position fully responsive; [I] Position not yet established. Special Management Attention Needed: [PR] Position partially responsive; [NR] Position nonresponsive; [X] Position established, evaluation deferred in view of proposed implementation; [IX] Position not yet established
		[R] The task group proposed to accept the recommendation with modification, as it believed informal review conferences would be more meaningful and less disruptive if held <u>before</u> a contracting officer's final decision on a dispute rather than <u>after</u>, as proposed by the Commission. The task group also opposed a 30-day contractor appeal period recommended by the Commission because it would weaken what was intended to be an informal review process. GSA questioned whether the role and authority of the contracting officer would be downgraded by this approach instead of being strengthened as was intended by the Commission. The decision at the interagency policy group's December meeting to reject this recommendation was made for two reasons: (1) it undermines and dilutes the decision-making authority and independence of the contracting officer whose objective is to settle a dispute without litigation by relying generally on legal counsel and other members of his team, and (2) it conflicts with recommendation A-13 that was made by the Commission to "clarify the role of the contracting officer as the focal point for making or obtaining a final decision on procurement" and to "allow the contracting officer wide latitude for the exercise of business judgment in representing the Government's interest." A notice of rejection is being prepared for publication in the Federal Register.
FMC	None	[X] The interagency policy group agreed with the task group in recommending acceptance of G-3 to retain multiagency appeals boards with added subpoena and discovery powers. However, it was decided to change the wording of the recommendation relating to the establishment of personnel and caseload standards from "minimum" to "recommended" standards. Implementation may be accomplished through issuing an FMC except for granting subpoena and discovery powers to boards of contract appeals. As legislation is needed for granting such powers, the necessary package is being sent to OFPP by GSA with a recommendation to accept.
		[R] The task group was opposed to adopting this recommendation because it believed that establishing regional small claims boards of contract appeals structure envisioned by the Commission would be (1) uneconomical due to the inadequate caseload and high processing cost, and (2) unnecessary since benefits to be derived from such a system are available under existing procedures. In rejecting the recommendation at its December 1974 meeting, the interagency policy group noted that accelerated procedures established by the boards since publication of the Commission report have been quite successful. It was also noted that the number of cases involving claimed amounts of $25,000, or less, is inadequate to justify the costs associated with the proposed system and that many appeals are handled without a hearing or are heard outside Washington, D. C., at a location mutually agreeable to the contractor and the Government. An appropriate notice of rejection is being prepared for publication in the Federal Register.

EXECUTIVE BRANCH POSITIONS AND IMPLEMENTING ACTIONS ON COMMISSION RECOMMENDATIONS AS OF JANUARY 1, 1975

Recommendation (GAO prepared these short-form statements of Commission recommendations. See indicated pages of Commission report for full texts)	Executive Branch Position in Process: Inter-agency task group led by	(Target) or actual date of task group report	Agency/industry comments due or under review	Date referred to OFPP for decision	Executive Branch Position Established: (Target) or actual date	Recommendation adopted, modified, or rejected	Implementation Phase, Legislation If Applicable: Bill or law	Date introduced or enacted
PART G--LEGAL AND ADMINISTRATIVE REMEDIES: (continued)								
5. Empower contracting agencies to decide, settle, and pay all contract claims or disputes (p. 22)	DOD	May 1974			Dec. 1974	Adopted	H.R. 9062 H.R. 16423	June 1973 Aug. 1974
6. Grant contractors option of direct access to Court of Claims or district courts (p. 23)	DOD	May 1974			Dec. 1974	Rejected	H.R. 9062 H.R. 16423	June 1973 Aug. 1974
7. Grant both Government and contractors judicial review of adverse decisions by agency appeals boards (with dissent) (p. 25)	DOD	May 1974		Jan 1975	(Mar. 1975)		H.R. 9062 H.R. 16423	June 1973 Aug. 1974

Implementation Phase — Executive Branch Action: Type	(Target) or actual completion date	GAO Comments on Responsiveness of Executive Branch Actions
		Legend [R] Position fully responsive [I] Position not yet established Special Management Attention Needed: [PR] Position partially responsive [NR] Position nonresponsive [X] Position established, evaluation deferred in view of proposed implementation [IX] Position not yet established
FPR/ ASPR	(Dec. 1975)	[R] The task group proposal to adopt this recommendation to empower contracting agencies to settle all contract claims and disputes was accepted by the interagency policy group at its December meeting. Implementation is to be accomplished through coordinated amendments to the FPR and ASPR and in this process private sector views will be solicited. The implementing "all disputes" contract clause proposed by the task group, together with a suggested addition by the Justice Department, are being forwarded to the FPR Director and ASPR Chairman for action. Justice suggests that a paragraph be added to the clause proposed by the task group making it absolutely clear that the clause gives the contracting officers, as well as the contract appeals board, jurisdiction over all contract claims, including not only those for reformation or rescission, but also those for breach of contract. Appropriate notice is being prepared for publication in the Federal Register. Issuance of the FPR and ASPR amendments is targeted for December 1975.
		[R] The task group opposed adopting this recommendation to allow contractors direct access to the Court of Claims and the district courts. This position was predicated on the belief that its implementation would (1) encourage "forum shopping" by contractors in enabling disputes arising under the same contract to be heard in as many as four different forums at the same time, (2) bring about inconsistencies in the law, (3) overburden the district courts, and (4) leave untapped the expertise developed by members of agency contract appeal boards. At its December meeting, the interagency policy group decided the recommendation should be rejected, pointing out that the rejection was not intended to preclude contractors from going to the courts on questions of law but was intended to urge contractors to exhaust available administrative forums before turning to the courts for relief. An appropriate notice of rejection is being prepared for publication in the Federal Register.
		[I] The task group favored adopting this recommendation to provide both Government and contractors judicial review of adverse decisions by agency boards of contract appeals. The task group's submission included an implementing legislative proposal needed to overcome a Supreme Court decision and amend the U.S. Code to permit the Government to appeal board decisions to the Court of Claims. At the December meeting of the interagency policy group, it was decided to refer G-7 to OFPP with the recommendation that it be accepted and implemented through the legislative process. It was noted that the number of actual appeals would probably be few since implementing the recommendation would merely give an agency head the authority to appeal.

EXECUTIVE BRANCH POSITIONS AND IMPLEMENTING ACTIONS ON COMMISSION RECOMMENDATIONS AS OF JANUARY 1, 1975

Recommendation (GAO prepared these short-form statements of Commission recommendations. See indicated pages of Commission report for full texts)	Executive Branch Position in Process: Inter-agency task group led by	(Target) or actual date of task group report	Agency/ industry comments due or under review	Date referred to OFPP for decision	Executive Branch Position Established: (Target) or actual date	Recommendation adopted, modified or rejected	Implementation Phase — Legislation If Applicable: Bill or law	Date introduced or enacted
PART G--LEGAL AND ADMINISTRATIVE REMEDIES: (continued)								
8. Establish uniform, short time limits for judicial review of administrative decisions (p. 27)	DOD	May 1974		Jan. 1975	(Mar. 1975)		H.R. 9062 H.R. 16423	June 1973 Aug. 1974
9. Modify existing remand practice to allow reviewing court the option to make findings of fact necessary to final disposition (p. 27)	DOD	May 1974			Dec. 1974	Rejected	H.R. 9062 H.R. 16423	June 1973 Aug. 1974
10. Expand jurisdictional limit of district courts from $10,000 to $100,000 (with dissent) (p. 28)	DOD	May 1974			Dec. 1974	Rejected	H.R. 9062 H.R. 16423	June 1973 Aug. 1974

Implementation Phase Executive Branch Action Type (Target) or actual completion date	GAO Comments on Responsiveness of Executive Branch Actions	
	Legend	Special Management Attention Needed
	[R] Position fully responsive	[PR] Position partially responsive
	[I] Position not yet established	[NR] Position nonresponsive
		[X] Position established, evaluation deferred in view of proposed implementation
		[IX] Position not yet established

[I] The task group favored adopting this recommendation to establish uniform and relatively short time periods within which litigants could seek judicial review of adverse decisions by administrative forums. The task group agreed with the Commission that the current 6-year period for filing such appeals is too long and endorsed its suggestion that a 60 to 90 day period would be more appropriate. The task group submitted an implementing legislative proposal to amend the Wunderlich Act and other sections of the U. S. Code to make the appeal period 90 days. At the December meeting of the interagency policy group, it was decided to refer the task group's proposal to OFPP with the recommendation that G-8 be accepted and implemented through the legislative process.

[R] The task group opposed adopting this recommendation to modify the present court remand practice so as to allow the reviewing court to take additional evidence to make a final disposition of the case. The task group believed that implementing the recommendation would increase rather than decrease the time and expense involved in litigation, citing the Commission's own study group's statistics supporting its position. The task group also noted that the recommendation conflicted with a Supreme Court decision holding that, in a suit governed by the Wunderlich Act, the Court of Claims is restricted to reviewing the administrative record and may not receive new evidence, a basic principle of administrative law that has been consistently applied by the Supreme Court. At the December meeting of the interagency policy group, it was decided that the recommendation should be rejected because it would lengthen the time frame and frustrate the established administrative process for resolving disputes. An appropriate notice of rejection is being prepared for publication in the Federal Register.

[R] The task group opposed adopting this recommendation to increase the monetary jurisdictional limit of the district courts to $100,000 in the belief that an expanded role for the district courts is not desirable. The task group also believed that implementating the recommendation would (1) only add to already overcrowded district court dockets; (2) result in "forum" shopping; (3) bring about uncertainty in procurement laws by increasing the probability of diversity of precedent; and (4) reduce reliance on the Court of Claims which the Commission felt should remain the leader in Government contract law. At the December meeting of the interagency policy group the recommendation was rejected because it would overload court dockets and place less reliance on the Court of Claims as the primary forum of Government contract litigation. An appropriate notice is being prepared for publication in the Federal Register.

EXECUTIVE BRANCH POSITIONS AND IMPLEMENTING ACTIONS ON COMMISSION RECOMMENDATIONS AS OF JANUARY 1, 1975

Recommendation (GAO prepared these short-form statements of Commission recommendations. See indicated pages of Commission report for full texts)	Executive Branch Position in Process: Inter-agency task group led by	(Target) or actual date of task group report	Agency/industry comments due or under review	Date referred to OFPP for decision	Executive Branch Position Established: (Target) or actual date	Recommendation adopted, modified, or rejected	Implementation Phase — Legislation If Applicable: Bill or law	Date introduced or enacted
PART G--LEGAL AND ADMINISTRATIVE REMEDIES: (continued)								
11. Pay interest on administrative and judicial claim awards (p. 29)	DOD	Mar. 1974			June 1974	Adopted	H.R. 9062 H.R. 16423	June 1973 Aug. 1974
12. Pay court judgments on contract claims from agency appropriations if feasible (p. 29)	DOD	May 1974			Dec. 1974	Rejected	H.R. 9062 H.R. 16423	June 1973 Aug. 1974
Disputes related to award of contracts:								
13. Promulage adequate information on contract-award protest procedures	ACE	Nov. 1973			July 1974	Adopted		

Implementation Phase: Executive Branch Action — Type	(Target) or actual completion date		GAO Comments on Responsiveness of Executive Branch Actions
			Legend
		[R]	Position fully responsive
		[I]	Position not yet established
			Special Management Attention Needed
		[PR]	Position partially responsive
		[NR]	Position nonresponsive
		[X]	Position established, evaluation deferred in view of proposed implementation
		[IX]	Position not yet established
FPR/ ASPR	July 1972 May 1972	[R]	Recommendation G-11 was adopted and implemented in both ASPR and FPR in 1972 as a result of GAO opinion B-174001 of October 27, 1971. The recommendation was also incorporated as a provision in H.R. 9062 and H.R. 16423 both of which were introduced in the 93d Congress but not acted upon before its adjournment. The bills proposed that interest be set at 6 percent per annum on administrative and judicial claim awards, whereas the FPR and ASPR allow the rate to be fixed by the Secretary of the Treasury with respect to those contracts to which the regulations are applicable.
		[R]	The executive branch accepted the task group majority proposal to reject the recommendation to pay court judgments on contract claims from appropriated funds. The Commission believed that this recommendation would alleviate possible agency reluctance to settle claims because (1) the current procedure of paying judgments from nonagency appropriations provides procuring agencies with incentive to avoid settlements in order to protect their own appropriated funds, and (2) this procedure makes it possible for agencies to hide from the Congress the total economic cost of procurements by precluding the need for agencies to obtain additional appropriations to pay judgments. The task group disagreed with the Commission contending that (1) claims are settled on their merits rather than on the basis of available funds and it is unlikely that an officer at the secretariat level would so lack impartiality as to send a case to court simply to protect his agency's appropriations against an adverse judgment, and (2) the Congress has merely to ask the procuring agency to find out the total cost of a procurement. The task group also pointed out that permanent, indefinite appropriations for judgments exceeding $100,000 enables successful claimants to be paid promptly and that this is unlikely to happen if an agency has to realign its own appropriated funds. Moreover, as the task group noted, requiring an agency to fund judgments from its own appropriations could disrupt its programs as well as financing them and, unless adequate amounts are appropriated and protected against use for immediate agency needs, a contractor would be dependent on the success and speed with which the agency could reprogram sufficient money to cover the contractor's award and judgment. At the December meeting of the interagency policy group, the recommendation was rejected because the network of agency review of claims was considered adequate and impartial enough to avoid payment of a claim merely to protect an agency's appropriated funds. An appropriate notice of rejection is being prepared for publication in the Federal Register.
FMC FPR ASPR	Aug. 1974 (July 1975) (July 1975)	[R]	In July 1974, the executive branch adopted recommendations G-13, G-14, G-15, G-16, and G-19 calling for establishing agency award protest procedures, continuing GAO as an award protest-resolving forum, getting more stringent time requirements in the GAO process, and requiring a high administrative level decision to justify an award while the protest is pending before GAO. Implementation was accomplished through issuing FMC 74-3 in August 1974. The language in the circular was revised after initial promulgation to meet some of GAO's objections. In September 1974, GSA initiated the action required to process appropriate FPR and ASPR amendments to comply with the circular. On January 1, 1975, the proposed FPR amendment was out for official comments from the executive agencies.

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PART G--LEGAL AND ADMINISTRATIVE REMEDIES: (continued)								
14. Continue to use GAO as an award protest-resolving forum (with dissent) (p. 40)	AEC	Nov. 1973			July 1974	Adopted		
15. Establish more expeditious and mandatory time requirements for processing protests through GAO (p. 42)	AEC	Nov. 1973			July 1974	Adopted		
16. Require high-level management review of any decision to award contract while protest is pending with GAO (p. 44)	AEC	Nov. 1973			July 1974	Adopted		
17. Have GAO continue to recommend terminations for Government convenience of improperly awarded contracts (p. 45)	AEC	Nov. 1973			June 1974	Adopted		
18. Improve contracting agency debriefing procedures (p. 48)	AEC	Nov. 1973			May 1974	Adopted		
19. Establish a preaward protest procedure in all contracting agencies (p. 48)	AEC	Nov. 1973			July 1974	Adopted		

Implementation Phase — Executive Branch Action Type	(Target) or actual completion date	GAO Comments on Responsiveness of Executive Branch Actions
		Legend [R] Position fully responsive [I] Position not yet established Special Management Attention Needed [PR] Position partially responsive [NR] Position nonresponsive [X] Position established, evaluation deferred in view of proposed implementation [IX] Position not yet established
FMC FPR ASPR	Aug. 1974 (July 1975) (July 1975)	[R] See G-13 comments
FMC FPR ASPR	Aug. 1974 (July 1975) (July 1975)	[R] See G-13 comments
FMC FPR ASPR	Aug. 1974 (July 1975) (July 1975)	[R] See G-13 comments
See comments		[R] Notice of adoption of this recommendation by the executive branch was published in the Federal register in July 1974. Implementation is not required as this recommendation is merely a continuation of GAO's present practice. GAO was notified in July 1974.
FPR/ ASPR	(June 1975)	[R] The executive branch adopted this recommendation. In letters to the FPR Director and the Secretary of Defense in May 1974, GSA requested that uniform implementation be effected through coordinated FPR and ASPR issuances. GSA also requested the resolving of three questions raised during consideration of the recommendation: whether debriefing should (1) identify factors on which the successful contractor was selected, (2) take place before or after contract award, and (3) apply to formally advertised and two-step procurements. Resolving these questions has resulted in certain differences between FPR and ASPR and has delayed issuing the required amendments which are now targeted for June 1975.
FMC FPR ASPR	Aug. 1974 (July 1975) (July 1975	[R] See G-13 comments

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Recommendation (GAO prepared these short-form statements of Commission recommendations. See indicated pages of Commission report for full texts)	Executive Branch Position in Process				Executive Branch Position Established		Implementation Phase Legislation If Applicable	
	Inter-agency task group led by	(Target) or actual date of task group report	Agency/industry comments due or under review	Date referred to OFPP for decision	(Target) or actual date	Recommendation adopted modified, or rejected	Bill or law	Date introduced or enacted
PART G--LEGAL AND ADMINISTRATIVE REMEDIES: (continued)								
20. Have GAO periodically review agency award protest procedures and practices (p. 49)	AEC	Nov. 1973			May 1974	Adopted		
Equitable and special management powers under Public Law 85-804:								
21. Make procurement authority permanent, not limited to periods of national emergency (with dissent) (p. 55)	AEC	July 1974		Aug. 1974	(June 1975)			

Implementation Phase Executive Branch Action Type (Target) or actual completion date	GAO Comments on Responsiveness of Executive Branch Actions Legend [R] Position fully responsive [I] Position not yet established Special Management Attention Needed [PR] Position partially responsive [NR] Position nonresponsive [X] Position established, evaluation deferred in view of proposed implementation [XI] Position not yet established
See Comments	[R] In May 1974, the executive branch adopted this recommendation to have GAO periodically review agency award protest procedures. The executive branch decided that no specific implementation other than the notice to GAO was necessary because the general thrust of the recommendation was already a matter of interest to GAO. The Comptroller General was notified by letter in July 1974. Later, GAO developed a preliminary program for the survey of award protest procedures and practices at the agency level. This program was tested in November at several military installations in Philadelphia, Pennsylvania. However, as the agencies are now in the process of revising their procedures and practices to comply with the new FMC 74-3 issued in August 1974 (see G-13), it was decided to defer a Government-wide in-depth review until late in 1975 to give the agencies sufficient time to complete the implementation of their revised protest procedures and practices.
	[IX] The task group unanimously proposed adopting recommendations G-21 and G-22 and submitted a proposed amendment to P.L. 85-804 to implement them. These recommendations would make the procurement authority under this law permanent and not limited to periods of national emergency and would extend the law to all contracting agencies. The task group also unanimously approved adopting recommendation G-23 but did not agree with the Commission that the recommendation should be implemented by incorporating P.L. 85-804 into the consolidated or primary procurement statute such as that to be established by H.R. 9061 then pending in the Congress. The task group proposed to accomplish implementing G-23 administratively by reclassifying P.L. 85-804 from title 50 in the U.S. Code, War and Defense, to title 41, Public Contracts. The GSA staff analysis indicated that this reclassification would not change the status of P.L. 85-804 and that the task group's proposal was in effect a rejection of G-23. Recommendation G-24 was rejected by the task group two to one. As pointed out in the GSA staff analysis, P.L. 85-804 was amended after publication of the Commission report so as to require agencies to notify the Congress before obligating the Government for $25 million or more under the P.L. 85-804 authority. The task group rejected the $1 million threshold recommended by the Commission as being too low and inconsistent with the concept of "emergency authority" granted by P.L. 85-804. However, the GSA staff analysis noted that the $25 million threshold needs further examination since it was tailored to national defense actions and not to those outside the defense area which would be covered by the proposed amendment to P.L. 85-804. At a meeting of the interagency policy group in July 1974, it was determined that the most expeditious way to complete implementation of this group of recommendations was through the legislative process and that the amendment to P.L. 85-804 proposed by the task group was consistent with the major thrust of the recommendations G-21 and G-22. Including the amended P.L. 85-804 into the primary procurement statute, as recommended in G-23 but rejected by the task group, was considered to be a relatively inconsequential issue. In referring the proposed legislative amendment to OMB (before OFPP established) in August 1974 for consideration and processing, GSA recommended that, because of uncertainty as to when the primary procurement statute would be enacted, it would be more expeditious to amend P.L. 85-804 now and to consider later the need to implement G-23 by incorporation into the primary statute. With respect to G-24, GSA also pointed out that the concerns which prompted the Commission to make the recommendation had been satisfied in a subsequent legislative process and that reopening the issue would serve no useful purpose. OFPP advised us that the legislative proposal had been referred to OMB's General Counsel for review and evaluation and that an executive branch position had not been established at January 1, 1975.

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PART G--LEGAL AND ADMINISTRATIVE REMEDIES: (continued)								
22. Extend law to all contracting agencies under regulations developed by OFPP and prescribed by the President (with dissent) (p. 57)	AEC	July 1974		Aug. 1974	(June 1975)			
23. Incorporate law into primary procurement statute (with dissent) (p. 59)	AEC	July 1974		Aug. 1974	(June 1975)			
24. Revise law to require report to Congress before obligating Government for more than $1 million (p. 59)	AEC	July 1974		Aug. 1974	(June 1975)			

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Implementation Phase		GAO Comments on Responsiveness of Executive Branch Actions
Executive Branch Action		Legend
Type	(Target) or actual comple-tion date	[R] Position fully responsive [I] Position not yet established Special Management Attention Needed [PR] Position partially responsive [NR] Position nonresponsive [X] Position established, evaluation deferred in view of proposed implementation [IX] Position not yet established

In the course of its review, GAO noted that the task group proposal did not address the dissenting position of one member of the Commission on Government Procurement. The Commissioner opposed recommendations G-21 thru G-23 on the grounds that (1) contractual modification without consideration is an extraordinary legal remedy and should be reserved for national defense in time of emergency; (2) there is already a statutory provision for correcting mistakes and for formally ratifying informal commitments and, although these actions might be more expeditiously handled under P.L. 85-804, there seems to be little purpose in extending duplication beyond the terms of that law; and (3) implementation of recommendation G-5 (which has now been adopted) will broaden the authority of procuring agencies to decide, settle, and pay all breach of contract claims. GAO believes OFPP, in making its determination of an executive branch position, should consider not only the dissenting Commissioner's views on G-21 through G-23, but also the question raised in the GSA staff analysis on G-24 concerning the applicability of the current $25 million defense threshold to procurement actions of the smaller civilian agencies.

[IX] See G-21 comments

[IX] See G-21 comments

[IX] See G-21 comments

EXECUTIVE BRANCH POSITIONS AND IMPLEMENTING ACTIONS ON COMMISSION RECOMMENDATIONS AS OF JANUARY 1, 1975

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PART H--SELECTED ISSUES OF LIABILITY--GOVERNMENT PROPERTY AND CATASTROPHIC ACCIDENTS:								
Self-insurance of Government property:								
1. Make Government act generally as a self-insurer for Government property loss or damage resulting from defects in finally accepted contractor-supplied items (p. 93)	DOD	Oct. 1973			Feb. 1974	Adopted		
2. Apply the same policy in recommendation H-1 to subcontractors (p. 97)	DOD	Oct. 1973			Feb. 1974	Adopted		
3. Limit rights of third-party transferee of Government property for loss or damage from defects in property to rights granted to Government under original procurement contract (p. 97)	DOD	Oct. 1973			Feb. 1974	Adopted		

Implementation Phase Executive Branch Action Type	 (Target) or actual completion date	GAO Comments on Responsiveness of Executive Branch Actions	
		Legend	
		[R] Position fully responsive [I] Position not yet established	**Special Management Attention Needed** [PR] Position partially responsive [NR] Position nonresponsive [X] Position established, evaluation deferred in view of proposed implementation [XI] Position not yet established

Type	(Target) or actual completion date		
FPR ASPR	(Feb. 1975) (Feb. 1975)	[R]	The executive branch adopted the general thrust of recommendations H-1, H-2, and H-3 making the Government act as self-insurer of its losses from property damages resulting from defects in contractor-supplied items. Implementation is to be accomplished by appropriate FPR and ASPR amendments. Although the Commission did not specifically single out sales under the Foreign Military Sales Act in making its recommendation H-3, the task group limited its proposed implementation of H-3 to such sales since it was uncertain whether to include other Government sales. In their official comments, the agencies generally agreed with the task group but some agencies recognized that implementing H-3 as proposed would not fully implement what the Commission intended. NASA, in particular, believed coverage should be extended to other sales as well as foreign military sales. In its July report, GAO also questioned the task group's proposal, recommending that OMB make a policy decision on H-3 and specifically inform the FPR Director and the ASPR Chairman as to what sales are to be covered by the implementation action. The ASPR amendment to implement H-3, which was issued in July, effective September 1, 1974, was limited to foreign military sales contracts. In September, the FPR implementation was proceeding on the same basis when the GSA Office of Procurement Management, calling attention to the views of NASA and GAO, requested the FPR Director to give special attention to expanding implementation of H-3 in the course of his coordinated effort with ASPR in implementing H-1 thru H-3. In its response to GAO's recommendation, OMB advised that GSA is now exploring expanding third-party rights limitations and that, in the course of developing appropriate FPR coverage, executive agencies will have an opportunity to provide an input which will be considered in the final version. OMB said that the FPR coverage will be closely coordinated with DOD to insure uniform coverage as far as practicable and that OFPP will review the regulations before issuance to assure responsiveness to the Commission's report. Issuance of the FPR is targeted for February 1975.
FPR ASPR	(Feb. 1975 (Feb. 1975)	[R]	See H-1 comments
FPR ASPR	(Feb. 1975) (Feb. 1975)	[X]	See H-1 comments

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PART H--SELECTED ISSUES OF LIABILITY--GOVERNMENT PROPERTY AND CATASTROPHIC ACCIDENTS: (continued)								
Catastrophic accidents:								
4. Establish by law prompt and adequate compensation to victims of catastrophic accidents under Government-connected programs (p. 101)	AEC	(Jan. 1975)						
5. Provide by law Government indemnification of contractors for liability in excess of available insurance resulting from catastrophic accidents under Government-connected programs (p. 101)	AEC	(Jan. 1975)						

Implementation Phase Executive Branch Action Type	(Target) or actual completion date	GAO Comments on Responsiveness of Executive Branch Actions
		Legend [R] Position fully responsive [I] Position not yet established Special Management Attention Needed [PR] Position partially responsive [NR] Position nonresponsive [X] Position established, evaluation deferred in view of proposed implementation [XI] Position not yet established
		[I] The task group report is being submitted in January 1975 proposing adoption of H-4 and H-5 to compensate victims of catastrophic accidents under Government connected programs and to indemnify contractors for liability from such accidents in excess of available insurance coverage. Implementing draft legislation will then be considered by the task group and submitted to GSA in a follow-on report. Establishing an executive branch position is targeted for June 1975.
		[I] See H-4 comments

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	Inter-agency task group led by	(Target) or actual date of task group report	Agency/ industry comments due or under review	Datel referred to OFPP for decision	(Target) or actual date	Recommendation adopted, modified, or rejected	Bill or law	Date introduced or enacted
PART I--PATENTS, TECHNICAL DATA, AND COPYRIGHTS:								
Patents:								
1. Promptly and uniformly implement revised Presidential statement of Government patent policy (p. 112)	NSF/ OST	Oct. 1973			Mar. 1974	Adopted		

Implementation Phase			GAO Comments on Responsiveness of Executive Branch Actions
Executive Branch Action			
Type	(Target) or actual comple-tion date		

Legend

[R] Position fully responsive
[I] Position not yet established

Special Management Attention Needed
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General (I-1 through I-13)

In accordance with the proposal of the task group (the Executive Subcommittee of the Committee on Government Patent Policy) and the majority of official agency comments, the executive branch adopted recommendations I-1, I-2, I-3, I-5, I-6, I-7, and I-9 through I-12, and rejected recommendations I-4 and I-8. These recommendations involve establishing uniform, Government-wide policies and procedures with respect to acquiring and using patents and technical data. Private sector comments were solicited through the Federal Register on I-4, to which there was no response, and on I-13. Because the Council of Defense and Space Industry Associations (CODSIA) objected to rejection of I-13, as proposed by the task group, it was returned to the task group to determine whether a change in position would be in order.

I-1 was implemented by appropriate amendments to FPR and FPMR in March 1974. Issuance of a conforming ASPR amendment is still pending. I-5 will also be implemented by FPR and ASPR amendments, the issuance of which is targeted for September 1975. The other eight adopted recommendations (I-2, I-3, I-6, I-7, and I-9 through I-12) were referred to the Federal Council for Science and Technology (FCST) by GSA in September 1974. GSA requested FCST to assume leadership in reviewing the executive branch positions and instituting appropriate implementing actions. FCST was also requested to oversee the task group's evaluation of CODSIA's objections to rejection of I-13 and advise GSA. In addition, FCST is reviewing I-1 for possible legislative revisions and is developing a legislative proposal for implementing the three adopted copyright recommendations (I-13, I-14, and I-15). In a January 1975 letter to GSA, FCST advised that it has established five working groups to develop implementing actions on the referred recommendations: (1) legislation, (2) licensing, (3) patents, (4) technical data, and (5) copyrights. Target completion dates have not as yet been established by FCST.

The interagency policy group and the OFPP have both concurred in the executive branch actions on these recommendations. Specific comments on the individual recommendations follow.

Type	Date		Comment
FPR	Mar. 1974	[R]	The main thrust of this recommendation--uniformly implementing the new Presidential Government Patent Policy--had already been implemented through amendments to FPR and FPMR when it was adopted by the executive branch. The ASPR revision to make it consistent with the President's 1971 patent policy statement and with the FPR as amended is still pending. The effective dates of the FPR and FPMR amendments have been suspended pending the outcome of litigation initiated by Public Citizen, Inc., challenging their constitutionality. Some agencies are also statutorily restricted from fully implementing the President's patent policies. FCST has been assigned the responsibility for drafting such legislative revisions as may be necessary to effect Government-wide implementation of these policies.
FPMR	Mar. 1974		
ASPR	None		

EXECUTIVE BRANCH POSITIONS AND IMPLEMENTING ACTIONS ON COMMISSION RECOMMENDATIONS AS OF JANUARY 1, 1975

Recommendation (GAO prepared these short-form statements of Commission recommendations. See indicated pages of Commission report for full texts)	Executive Branch Position in Process				Executive Branch Position Established		Implementation Phase	
	Inter-agency task group led by	(Target) or actual date of task group report	Agency/ industry comments due or under review	Date referred to OFPP for decision	(Target) or actual date	Recommendation adopted, modified, or rejected	Legislation If Applicable: Bill or law	Legislation If Applicable: Date introduced or enacted
PART I--PATENTS, TECHNICAL DATA, AND COPYRIGHTS: (continued)								
2. Enact legislation to clarify authority of all agencies to issue exclusive licenses under patents held by them (p. 114)	NSF/ OST	Dec. 1973			July 1974	Adopted		
3. Supplement Presidential policy by adopting uniform procedures for exercising rights retained by the Government under the policy (p. 114)	NSF/ OST	Dec. 1973			July 1974	Adopted		
4. Amend statute to make authorization and consent automatic except when expressly withheld or withdrawn by agency on a specific patent (p. 123)	NSF/ OST	Dec. 1973			Aug. 1974	Rejected		

Implementation Phase			GAO Comments on Responsiveness of Executive Branch Actions
Executive Branch Action			Legend
Type	(Target) or actual comple-tion date		[R] Position fully responsive [I] Position not yet established Special Management Attention Needed [PR] Position partially responsive [NR] Position nonresponsive [X] Position established, evaluation deferred in view of proposed implementation [IX] Position not yet established
See Comments	None	[R]	In adopting I-2, the executive branch requested FCST to consider drafting appropriate implementing legislation recommended by the executive subcommittee task group. Enactment of this legislation would make clear the authority of all agencies to issue exclusive licenses under patents held by them. The interagency policy group and a majority of the agencies in their official comments concurred with the task group. The prevailing view was that there is adequate legal authority to support the patent licensing program authorized by the President's 1971 patent policy statement as implemented by FPR and FPMR. However, it was believed that these regulations contain too many restrictions and do not provide sufficient flexibility for a fully effective licensing program. The executive branch concluded that specific legislative authority is needed to give agencies greater administrative flexibility which will allow them to grant licenses without some or all of the restrictions now required by the present exclusive licensing regulations. As noted in the G-1 comments, these regulations have been suspended pending the outcome of litigation challenging the constitutionality of some portions of FPR and FPMR. The executive branch believes that FCST's drafting of the requested legislative proposal should not await the outcome of the pending litigation if FCST determines early legislation is warranted. The executive branch believes that such legislation would constitute regulations that are "in addition to" rather than "in replacement of" existing agency rules.
See Comments	None	[R]	In adopting I-3, interagency policy group and a majority of the agencies agreed that implementation by FCST should be determined on the basis of a short study to ascertain ways in which the recommendation may be accomplished, including how "march-in" rights can be improved and strengthened. March-in rights are those rights reserved by the Government through which it can require a contractor to license others under special circumstances. A special task force established to make the study has completed its work. FCST is now considering the appropriate implementation action.
		[R]	The task group recognized that certain benefits were to be realized from the two interrelated provisions of I-4 which would make authorization and consent in all R&D and supply-type contracts authomatic, unless expressly withdrawn as to specific patents. The task group noted, however, that areas of contractor uncertainty concerning authorization and consent largely arise when the contract is silent or the Government grants only limited authorization and consent. The task group recommended against adopting I-4 because it believed that these areas of uncertainty are relatively few and avoidable by improving administrative practices and that the withdrawal of authority for specific patents would be rare and could disrupt the procurement process. The interagency policy group and the consensus of official agency comments were in agreement with the task group and the recommendation was rejected in August 1974.

EXECUTIVE BRANCH POSITIONS AND IMPLEMENTING ACTIONS ON COMMISSION RECOMMENDATIONS AS OF JANUARY 1, 1975

Recommendation (GAO prepared these short-form statements of Commission recommendations. See indicated pages of Commission report for full texts)	Executive Branch Position in Process: Inter-agency task group led by	(Target) or actual date of task group report	Agency/industry comments due or under review	Date referred to OFPP for decision	Executive Branch Position Established: (Target) or actual date	Recommendation adopted, modified, or rejected	Implementation Phase — Legislation If Applicable: Bill or law	Date introduced or enacted
PART I--PATENTS, TECHNICAL DATA AND COPYRIGHTS: (continued)								
5. Amend agency regulations and clauses to provide that warranties against patent infringement be specified rather than implied in contracts (p. 123)	NSF/ OST	Dec. 1973			July 1974	Adopted		
6. Authorize agencies to settle patent infringement claims with available appropriations before litigation (p. 124)	NSF/ OST	Dec. 1973			July 1974	Adopted		
7. Grant agencies the statutory authority to acquire patent applications, and licenses or other related rights (p. 124)	NSF/ OST	Dec. 1973			July 1974	Adopted		

Implementation Phase: Executive Branch Action — Type	(Target) or actual completion date	GAO Comments on Responsiveness of Executive Branch Actions
		Legend [R] Position fully responsive [I] Position not yet established Special Management Attention Needed: [PR] Position partially responsive [NR] Position nonresponsive [X] Position established, evaluation deferred in view of proposed implementation [IX] Position not yet established
FPR/ ASPR	(Sept. 1975)	[R] The executive subcommittee considered the Commission recommendation unclear as to the contemplated contractual provision, whether it should expressly set forth availability to the Government of commercial warranties against patent infringement or should expressly negate the availability of such warranties. The task group believed that the first interpretation was intended by the Commission and that inclusion of the provision should be made mandatory, unless expressly excluded, to insure the availability of the warranties. The task group also believed that implementation could be accomplished without legislation and recommended that it be done by appropriate amendments to FPR and ASPR. The executive branch accepted the task group's recommendation and the appropriate amendments to FPR and ASPR are targeted for September 1975.
See Comments	None	[R] The executive branch accepted the proposal of the patent policy executive subcommittee to adopt the recommendation authorizing agencies to settle patent infringement claims with available appropriations, and to implement it by enacting legislation as outlined in sections 6 to 8 of the draft bill proposed by the Commission in appendix B to part IV of its report, and by concomitantly repealing all existing individual agency authorizing legislation. The proposed legislation also includes provisions authorizing agencies to acquire patents, licenses, etc. (I-7), technical data (I-11) and copyrights (I-15). The executive subcommittee pointed out that a recent opinion of the Comptroller General emphasizes the need for recommended agency authorization to settle patent infringement claims before litigation. The Comptroller General stated that, in the absence of express statutory authorization, an agency cannot enter into a license agreement with a patent owner either to settle past unauthorized Governmental use or to authorize future Governmental use of the owner's patented inventions. Responsibility for the necessary implementation action has been assigned to FCST.
See Comments	None	[R] See I-6 comments

EXECUTIVE BRANCH POSITIONS AND IMPLEMENTING ACTIONS ON COMMISSION RECOMMENDATIONS AS OF JANUARY 1, 1975

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PART I--PATENTS, TECHNICAL DATA AND COPYRIGHTS: (continued)								
8. Give Federal district courts concurrent jurisdiction with Court of Claims for patent suits within the statutory jurisdictional dollar limit (p. 124)	NSF/ OST	Dec. 1973			Aug. 1974	Rejected		
Technical data:								
9. Amend or repeal statutes limiting agency flexibility for rights in technical data (p. 129)	NSF/ OST	Dec. 1973			Aug. 1974	Adopted		

Implementation Phase — Executive Branch Action: Type	(Target) or actual completion date	GAO Comments on Responsiveness of Executive Branch Actions

Legend

[R] Position fully responsive
[I] Position not yet established

Special Management Attention Needed

[PR] Position partially responsive
[NR] Position nonresponsive
[X] Position established, evaluation deferred in view of proposed implementation
[IX] Position not yet established

		[R]	The executive subcommittee task group was against adopting recommendation I-8 giving Federal district courts concurrent jurisdiction with the Court of Claims in patent suits. It doubted that adoption could achieve the objective of reducing a patent claimant's litigation expenses due to the district court's limited jurisdiction and lack of the expertise possessed by the Court of Claims in this area. The task group believes that, instead of providing for additional avenues of judicial relief, the objective could be better achieved by providing for effective administrative consideration of patent claims by all agencies, an initial step being adoption of I-6 and I-7 above. The interagency policy group and all of the agency comments, with the exception of NASA, concurred with the executive subcommittee. According to a GSA staff analysis, Justice believes that the Court of Claims is ideally suited to assist claimants against the Government and tailor its assistance to the peculiarities of the Governmental process. On the other hand, NASA feels that there has been a general over-reaction by the "patent bar" against this recommendation and that all the arguments made would similarly apply to removing concurrent jurisdiction from the district court in the resolution of contractors' claims against the Government. In August 1974, the executive branch decided to reject this recommendation.
See Comments	None	[R]	In accepting I-9 to repeal statutory limitations on agency flexibility with respect to rights in technical data, GSA, as well as the executive subcommittee task group, recognized the need for FCST to consider its implementation jointly with that of I-10 and I-12. This position was based on a belief by the executive subcommittee that implementation of I-10 and I-12 will necessarily include a review of existing laws to determine the need for repeal or amendment to accomplish the specific objectives of those recommendations and that the repeal or amendment of statutes limiting agency flexibility could be considered at the same time. It was thought that this approach is better than a one-time repeal or amendment of present restrictive statutes inasmuch as the formulation of Government data policy may require several years. Since a working group with broad representation from interested agencies will be needed to formulate such a policy, in view of the diversity of agency views, and since these representatives will probably not be assigned full time to the task, it is anticipated that implementation could take as long as two years or more. The view of NASA is that, in the implementation process, technical data recommendations I-9 thru I-13 should be concurrently considered with related copyright recommendations for example, I-9 with I-14, I-11 with I-15, and I-10 and I-12 with I-16. The GSA staff analysis noted that, since copyright recommendations I-14 through I-16 had also been referred to FCST, consolidation of related matters in final implementation would be for FCST to decide.

EXECUTIVE BRANCH POSITIONS AND IMPLEMENTING ACTIONS ON COMMISSION RECOMMENDATIONS AS OF JANUARY 1, 1975

Recommendation (GAO prepared these short-form statements of Commission recommendations. See indicated pages of Commission report for full texts)	Executive Branch Position in Process: Inter-agency task group led by	(Target) or actual date of task group report	Agency/industry comments due or under review	Date referred to OFPP for decision	Executive Branch Position Established: (Target) or actual date	Recommendation adopted, modified, or rejected	Implementation Phase, Legislation If Applicable: Bill or law	Date introduced or enacted
PART I--PATENTS, TECHNICAL DATA AND COPYRIGHTS: (continued)								
10. Develop and evaluate through OFPP and Federal Council for Science and Technology the implementation of a Government policy on rights in technical data supplied under Government contracts including the relationship of prime contractor and subcontractor rights (p. 129)	NSF/ OST	Dec. 1973			Aug. 1974	Adopted		
11. Authorize agencies to acquire rights or interest in technical data and information (p. 129)	NSF/ OST	Dec. 1973			Aug. 1974	Adopted		
12. Develop and evaluate through OFPP and Federal Council for Science and Technology the implementation of a Governmentwide policy on treatment of technical data submitted with proposals or other related documents (p. 130)	NSF/ OST	Dec. 1973			Aug. 1974	Adopted		
13. Establish a remedy for Government misuse of confidential information supplied to it (p. 131)	NSF/ OST	Dec. 1973	X		(Feb. 1975)			

Implementation Phase — Executive Branch Action: Type	(Target) or actual completion date	GAO Comments on Responsiveness of Executive Branch Actions
		Legend [R] Position fully responsive [I] Position not yet established Special Management Attention Needed [PR] Position partially responsive [NR] Position nonresponsive [X] Position established, evaluation deferred in view of proposed implementation [IX] Position not yet established
See Comments	None	[R] See I-9 comments
See Comments	None	[R] The executive branch adopted this recommendation authorizing agencies to acquire rights in technical data and referred it to FCST for implementation with the suggestion that section 6 of the draft bill, proposed by the Commission in appendix B to part IV of its report, be used for this purpose. Sections 6 to 8 of the bill proposed by the Commission also cover the acquisition of rights in patents (I-7) and copyrights (I-15).
See Comments	None	[R] See I-9 comments
		[IX] The task group concluded there was no immediate need for adopting this recommendation because it found no instance when a remedy was not available to parties injured by Government misuse of information confidentially supplied to the Government. The task group stated that existing statutes provide criminal penalties for any such misuse, remedies for breach of contract, and avenues of timely protest to GAO, etc. The task group believed that legislation of appropriate scope should be enacted only if actual need could be demonstrated. All of the executive agencies agreed with the task group's position. However, the Council of Defense and Space Industry Associations (CODSIA) disagreed with the task group's proposal and the rationale on which it was based. CODSIA contended that the task group directed its attention to narrow, hypertechnical, and legal considerations rather than to reasoning and public interest considerations which ran through the Commission report and Federal court decisions. CODSIA pointed out that implementing the recommendation does not require congressional action and could be accomplished by issuing appropriate regulations by agency heads which would conform to the legal standards laid down in past court cases. GSA decided that CODSIA's views warranted careful examination by the task group and, in September 1974, returned the recommendation to the group to determine whether a change in its position was in order. FCST is to review the task group's determination. GSA received advice in January 1975 that a determination to accept or reject CODSIA's position is being deferred until FCST decides on the implementation of I-10 and I-12.

EXECUTIVE BRANCH POSITIONS AND IMPLEMENTING ACTIONS ON COMMISSION RECOMMENDATIONS AS OF JANUARY 1, 1975

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	Inter-agency task group led by	(Target) or actual date of task group report	Agency/ indus-try comments due or under review	Date referred to OFPP for decision	(Target) or actual date	Recommen-dation adopted, modified, or rejected	Legislation If Applicable: Bill or law	Date intro-duced or enacted
PART I--PATENTS, TECHNICAL DATA AND COPYRIGHTS: (continued)								
Copyrights:								
14. Amend or repeal statutes limiting flexibility in dealing with publications of works developed under Government contracts. (p. 133)	NASA	Dec. 1973			May 1974	Adopted		
15. Give all agencies the legislative authority to acquire private copyrights or interests therein (p. 133)	NASA	Sept. 1973			May 1974	Adopted		
16. Establish an interagency task force under OFPP to develop and evaluate implementation of a Government copyright policy (p. 134)	NASA	Jan. 1974			May 1974	Adopted		

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Implementation Phase: Executive Branch Action — Type	(Target) or actual completion date		GAO Comments on Responsiveness of Executive Branch Actions
			[R] Position fully responsive; [I] Position not yet established. Special Management Attention Needed: [PR] Position partially responsive; [NR] Position nonresponsive; [X] Position established, evaluation deferred in view of proposed implementation; [IX] Position not yet established
See Comments	None	[X]	In accepting this recommendation to remove statutory provisions limiting flexibility in publicizing works under Government contracts, the executive branch requested FCST to develop an appropriate legislative proposal to implement I-14 and I-15 and a Government copyright policy to implement I-16. As explained in earlier comments, FCST has also been requested, in the implementation process, to consider the interrelationship of the I series of recommendations on copyrights, patents, and technical data and to determine the extent to which these recommendations should be consolidated in the ultimate implementation action. Both GAO and GSA staff analyses noted that the task group's position, which was adopted by the executive branch, failed (1) to consider statutes which "inhibit" an agency in "controlling" the publication of works by withholding such works from the public and (2) to determine whether the general statutory prohibition against copyrights for works within the public domain applies to works developed by Government contractors or only to works of Government employees. GAO suggests that, in developing an implementing legislative proposal and a Government copyright policy, FCST give appropriate consideration to the effect of the inhibiting statutes as well as the general statutory prohibition and the need for legislative revision.
See Comments	None	[X]	See I-14 comments
See Comments	None	[X]	See I-14 comments

EXECUTIVE BRANCH POSITIONS AND IMPLEMENTING ACTIONS ON COMMISSION RECOMMENDATIONS AS OF JANUARY 1, 1975

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PART J--OTHER STATUTORY CONSIDERATIONS:								
Consolidated procurement title in U.S. Code:								
1. Establish a program to develop changes needed to organize and consolidate procurement statutes (p. 169)	DOJ	(Mar. 1975)						
Statutes of limited application:								
2. Extend Truth-in-Negotiations Act to all procurement agencies; develop coordinated regulations for interpreting and applying act (p. 187)	GSA	Sept. 1973			Feb. 1974	Adopted	H.R. 9061	June 1793
3. Extend Renegotiation Act for periods of 5 years (p. 188)	Renegotiation Board	Apr. 1974		June 1974	(Aug. 1975)			

Implementation Phase — Executive Branch Action: Type	(Target) or actual completion date	GAO Comments on Responsiveness of Executive Branch Actions
		[R] Position fully responsive [I] Position not yet established Special Management Attention Needed [PR] Position partially responsive [NR] Position nonresponsive [X] Position established, evaluation deferred in view of proposed implementation [IX] Position not yet established

[I] This recommendation was initially assigned to Justice by OMB in March 1973 for developing a proposed executive branch position and plan of implementation. The task group's report was submitted to GSA in June 1973, but was returned for modification and a proposed implementation plan. In July 1974 the task group leader advised that he was then awaiting additional information on the cost of the statutory recodification program and that the revised report would be submitted that month. As of January 1, 1975, a revised report from Justice had not been received by GSA. The task group now advises that the report will be submitted in January 1975.

[R] The executive branch adopted the Commission recommendation to extend the Truth-in-Negotiations act to all procurement agencies. Implementation was to be accomplished through H.R. 9061, a bill then pending in the Congress to consolidate the two basic procurement statutes (see A-2). Only the cost and pricing aspects of the act are being considered under J-2, the other aspects (competitive discussions) having been considered under recommendation A-4. Although the cost and pricing aspects of the Truth-in-Negotiations Act are incorporated in ASPR and, with some differences, have been extended administratively to the civilian agencies through FPR, the executive branch has determined that a legislative extension of the act to civilian agencies is needed to provide statutory standing, permanence, and a greater legal force and effect than is presently afforded by coverage in the FPR.

[I] In its April 1974 submission, the task group recommended adopting Commission recommendations J-3 through J-6 extending the Renegotiation Act, making it applicable to all agencies, and clarifying the profit criteria. In June 1974, the task group's legislative proposal for implementing J-3 through J-6 was referred to OMB (before OFPP established) with the recommendation that it adopt the task group's position and process the proposal. In its letter to OMB, GSA called attention to amendatory legislation which the Renegotiation Board had introduced through OMB and to the fact that this legislation was conflicting and not responsive to the Commission's recommendations since it incorporated only the task group's J-6 position. In its July report, GAO pointed out that it considered the task group's J-6 proposal to be nonresponsive because the changes suggested to improve the statutory language relating to the profit factors, or criteria, did not include any guidelines for their application. In a May 1973 report on the Renegotiation Board's operations, GAO noted that the lack of such guidelines could affect the propriety and consistency of the Board's determinations.

In 1974, the Congress extended the Renegotiation Act to December 31, 1975 to (1) provide sufficient time for a thorough analysis of the renegotiation process by the staff of the Joint Committee on Internal Revenue Taxation in consultation with the staff of the Renegotiation Board, and (2) enable the committee to hold public hearings on the recommended changes and thoroughly review the entire process to determine how and to what extent the act should be amended. The Congress

EXECUTIVE BRANCH POSITIONS AND IMPLEMENTING ACTIONS ON COMMISSION RECOMMENDATIONS AS OF JANUARY 1, 1975

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PART J--OTHER STATUTORY CONSIDERATIONS: (continued)								
4. Extend Renegotiation Act to contracts of all Government agencies (p. 188)	Renegotiation Board	Apr. 1974		June 1974	(Aug. 1975)			
5. Raise Renegotiation Act jurisdictional amount to $2 million for sales to Government and $50,000 for brokers' fees (with dissent) (p. 189)	Renegotiation Board	Apr. 1974		June 1974	(Aug. 1975)			
6. Expand and clarify profit criteria used by the Renegotiation Board (with dissent) (p. 190)	Renegotiation Board	Apr. 1974		June 1974	(Aug. 1975)			

Implementation Phase		GAO Comments on Responsiveness of Executive Branch Actions	
Executive Branch Action			Special Management Attention Needed
Type	(Target) or actual comple-tion date	[R] Position fully responsive [I] Position not yet established	[PR] Position partially responsive [NR] Position nonresponsive [X] Position established, evaluation deferred in view of proposed implementation [IX] Position not yet established

specifically authorized the joint committee staff to make a comprehensive study and investigation of the operation and effect of the act to determine if it should be extended beyond the year 1975 and, if so, how the administration of the act could be improved. The staff was directed to consider whether exemption criteria and statutory factors for determining excess profits should be changed to make the act fairer, more effective, and more objective. The staff was also directed, in making the study, to consult with the staffs of the Renegotiation Board, GAO, Cost Accounting Standards Board, and Joint Economic Committee. A report with such recommendations as deemed appropriate is to be submitted by August 31, 1975, to the House Ways and Means Committee and the Senate Finance Committee as well as to the Joint Committee on Internal Revenue Taxation.

As the results of this study will obviously have an impact on OFPP's disposition of these recommendations, establishing an executive branch position has been delayed until then.

[I] See J-3 comments

[I] See J-3 comments

[IX] See J-3 comments

Representative BROWN of Ohio. Mr. Staats, my concern is whether or not this kind of a situation is covered, in your opinion, by the recommendations made by the Procurement Commission, or do we need some additional work in these one-of-a-kind fields, such as fast breeder reactors?

Now, we are starting in the Interstate Commerce Committee, and have just passed in subcommittee the other day, legislation requested by the administration for reserve-oil storage. This is a one-of-a-kind project. The question still has to be determined whether we are going to put 1,800 billion barrels of oil in salt domes someplace. That is a new idea—well, not a new idea but a new effort. It has been done elsewhere, but it is a new effort for us. We are talking about $3.3 billion. And the question is whether to do this or whether to put them in steel tanks someplace, or how we are going to do it.

Now, my guess is that there are no very precise rules for such a program except the detailed rules the Procurement Commission addressed itself to. My question, I guess, and I underscore it again, is do we need additional effort or do you think the Procurement Commission studies address themselves sufficiently to these unique kinds of Federal programs?

Mr. STAATS. I would say with respect to the Procurement Commission's report, as to whether it would apply to the breeder reactor program—probably not very much except for the point that I was making; namely, on the need for making someone responsible for program management. That was not done here. This is in the process of being done.

As we pointed out in our oral statement, on March 10, I believe it was, ERDA submitted to the Joint Committee on Atomic Energy a plan for reorganizing the management of the Clinch River breeder reactor project. Previously, it was in effect run by a committee.

Representative BROWN of Ohio. Oh, boy.

Mr. STAATS. A committee made up of the AEC and two utility companies—TVA and Commonwealth Edison Co. The Joint Committee has that matter before it now. I believe it is supposed to lie there for 45 days before it goes into effect. The Joint Committee did ask us to comment on the reorganization, and we supplied that. We have a report on that. We would be happy to include that in the record.

But, the principal concern that we had was that you just cannot operate a program of this type—I believe it is ERDA's concern too, in the manner of a committee. We had some question of whether or not the new ERDA plan went far enough in making it clear who was the boss of this program. And I am told that they are in the process of making some further changes to clarify that situation.

Chairman HUMPHREY. We would like to get your report on that again and place it in the record so it has continuity.

Mr. STAATS. Yes, Mr. Chairman.

[The report follows:]

REPORT TO THE
JOINT COMMITTEE
ON ATOMIC ENERGY
CONGRESS OF THE UNITED STATES

Comments On Energy Research And Development Administration's Proposed Arrangement For The Clinch River Breeder Reactor Demonstration Plant Project

BY THE COMPTROLLER GENERAL
OF THE UNITED STATES

RED-75-361

APR 4 1975

COMPTROLLER GENERAL OF THE UNITED STATES
WASHINGTON, D.C. 20548

B-164105

The Honorable John Pastore, Chairman
Joint Committee on Atomic Energy
Congress of the United States

Dear Mr. Chairman:

This report is in response to your letter of March 14, 1975, asking us to evaluate certain proposed legislation submitted by the Energy Research and Development Administration on March 10, 1975, to the Joint Committee on Atomic Energy. This proposed legislation involves major revisions to the authorization for the Clinch River Breeder Reactor Demonstration (CRBR) plant project along with proposed changes to the existing underlying documents governing the project.

We reviewed the proposed legislation and underlying documents submitted to the Joint Committee. Our review focused on changes the Energy Research and Development Administration is proposing to the existing documents. We held discussions with Administration representatives knowledgeable of, and responsible for, preparing the proposed legislation and other documents. The major changes being proposed as well as the concerns we have are described in the enclosure.

Our major observations regarding the proposed legislation and underlying documents are:

--An additional criterion is being added to the arrangement to allow the utility participants to withdraw their support from the project if there is a disagreement over major changes in reference design and specifications. This could allow the utility participants to terminate their involvement over design changes which may be brought about by actions of the Nuclear Regulatory Commission.

--The Administration's intent is to assume responsibility for managing the project with a single, integrated Government-utility staffed organization. However, the various documents submitted to the Joint Committee do not clearly delineate the manner in which the project will be managed. Rather, they contain ambiguous and seemingly inconsistent language regarding respon-

B-164105

sibilities and management. Although Administration officials believe that the documents are clear, they told us that the documents will be revised to state that the Administration will manage the project.

--Administration officials believe that the Government's share of the total project cost is now authorized under Public Law 91-273 and that the proposed legislation would continue such authorization by virtue of one of the underlying documents lying before the Joint Committee for 45 days, as required by the basic enabling legislation. It is not clear to us that the legislative history authorizing this project supports this view. The Administration believes that the Government's share ($1.468 billion) of the currently estimated total project cost ($1.736 billion) is likewise fully authorized by virtue of one of the underlying documents lying before the Joint Committee for 45 days, as required by the basic authorizing legislation. However, the proposed legislation seeks spending authority for only 1 year (plus the 3-month transition period) and the authorization of appropriations as necessary for a 5-year operating period.

Because of time limitations, we did not obtain the Administration's formal comments on this report, but the contents were discussed with Administration representatives during our review and their comments were incorporated where appropriate.

We are sending a copy of this report today to the Vice Chairman of your Committee. We are also sending copies to the Administrator, Energy Research and Development Administration. We do not plan to distribute this report further unless you agree or publicly announce its contents.

Sincerely yours,

Elmer B. Staats

Comptroller General
of the United States

Enclosure

CONTENTS

ABBREVIATIONS

AEC	Atomic Energy Commission
BRC	Breeder Reactor Corporation
CRBR	Clinch River Breeder Reactor
CE	Commonwealth Edison Company
ERDA	Energy Research and Development Administration
LMFBR	Liquid Metal Fast Breeder Reactor
PMC	Project Management Corporation
TVA	Tennessee Valley Authority

COMMENTS ON ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION'S PROPOSED ARRANGEMENT FOR THE CLINCH RIVER BREEDER REACTOR DEMONSTRATION PLANT PROJECT

INTRODUCTION

In a letter of March 14, 1975, the Chairman, Joint Committee on Atomic Energy, asked the General Accounting Office to evaluate certain proposed legislation submitted by the Energy Research and Development Administration (ERDA) on March 10, 1975, to the Joint Committee on Atomic Energy. This proposed legislation, with a bill analysis, involves major revisions to the authorization for the Clinch River Breeder Reactor Demonstration (CRBR) plant project along with proposed changes to the existing underlying documents governing the project. These underlying documents are: (1) amended statutory criteria for Fourth Round Arrangements under ERDA's Power Reactor Demonstration Program (Criteria) and (2) revised program justification data arrangement No. 72-106 (Justification Data).

In 1970 the Congress authorized (Public Law 91-273, as amended) the Atomic Energy Commission (AEC)--the predecessor agency to ERDA--to enter into cooperative arrangements with private industry to build and operate the CRBR project. On July 25, 1973, AEC entered into a four-party contract among AEC, the Tennessee Valley Authority (TVA), the Commonwealth Edison Company (CE), and the Project Management Corporation (PMC) to develop and demonstrate successfully a Liquid Metal Fast Breeder Reactor (LMFBR) by 1980. PMC was created in March 1972 to manage the project and administer the contracts for the design, construction, and operation of the plant. PMC is headed by a five-member board of directors: two from TVA, two from CE, and one from the Breeder Reactor Corporation (BRC), which was created at the same time to collect contributions from various electric utilities and to remit the collected funds to PMC to carry out the project.

AEC estimated that $699 million would be required to design, construct, and operate the project, of which private project participants, primarily utilities, were expected to provide from $274 to $294 million, including $20 to $40 million from reactor manufacturers. AEC was authorized to contribute a total of about $422 million, $92 million[1] of which was to be in direct financial assistance, $10 million in special nuclear material, and $320 million in development

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[1]$100 million has been authorized of which $8 million was for the Project Definition Phase of the program.

work from AEC's ongoing LMFBR base program. Base program funds were limited to 50 percent of the then estimated capital cost of the plant. The direct assistance and base program funds were restricted as to what they could be used for. In general, they could not be used for end capital items[1] for the plant.

ERDA's cost estimate for completing the CRBR project is now $1.736 billion--an increase of more than $1 billion. Because utility contributions were fixed, ERDA, by contract, accepted the open-end financial risks connected with the project and agreed to seek funds for any cost increase. Because of the large increase in the financial contribution needed from the Government, ERDA has proposed changes in the CRBR arrangement which would enable ERDA, instead of PMC, to direct and manage the project with a single, integrated Government-utility staffed organization.

Through the proposed legislation, amended Criteria, and revised Justification Data, ERDA is also seeking authorization for a single funding category to cover the research and development, engineering, design, construction, testing, and operation of the plant rather than the two funds--CRBR direct assistance funds and base program funds through which it has been participating in the project. The authorization requested would eliminate restrictions on the use of the two separate funds and provide ERDA the required means to support the project.

DESCRIPTION OF THE DOCUMENTS SUBMITTED TO THE JOINT COMMITTEE

Section 106(b) of Public Law 91-273, as amended, provides that, before ERDA enters into any arrangement or amendment thereto for participating in the research and development, design, construction, and operation of a liquid metal fast breeder reactor demonstration plant, ERDA must submit the basis for such an arrangement to the Joint Committee on Atomic Energy. The law further provides that the basis for such an arrangement must lie before the Joint Committee for 45 days while the Congress is in session, unless the Joint Committee waives the period. The arrangement and any amendments thereto, subsequently entered into, must be in accordance with that basis. On March 10, 1975, ERDA submitted to

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[1]"End capital items" are plant and equipment components or hardware items which have identifiable characteristics with a life of at least 1 year, are intended for use in accomplishing the purpose of the plant, and are generally capitalized over their useful life without contemplated disposal.

the Joint Committee the Justification Data, Criteria, and bill analysis to describe the proposed changes to the present arrangement.

With Joint Committee approval of the Justification Data, ERDA plans to modify the existing four-party contract to recognize ERDA's assumption of project management control. ERDA officials are presently negotiating with the other three parties--CE, TVA, and PMC--based on the terms of the proposed legislative revisions and subject to any changes made in those revisions. ERDA officials advised us that, and we agree, technically the Joint Committee does not have approval rights over modifications to the four-party contract. However, ERDA plans to work closely with the Joint Committee staff to insure that the modified contract is consistent with the Justification Data. ERDA plans to provide a copy of the modified contract to the Joint Committee after it has been executed.

Bill analysis

A bill analysis is a standard document accompanying any proposed legislation. In cases of disagreement over interpretation of legislation, it helps clarify the author's intent. As such, it is an important part of the history of any legislation.

One section of the analysis submitted by ERDA describes the prominent features of the revised management arrangements in the areas of (1) relationship and responsibilities of the parties, (2) financial aspects, and (3) protection of basic interest of the parties. According to ERDA officials, this section has been agreed to and approved by all the major parties involved in managing the project--ERDA, CE, TVA, PMC, and BRC. The parties are using this section as a basis for negotiating a modification to the current four-party contract.

Criteria

The Criteria, which is referred to in Public Law 91-273, describes the design requirements and objectives of the LMFBR program. It establishes the basic parameters of the relationship of ERDA to potential contractors and describes the anticipated degree of participation by ERDA, utility companies, and reactor manufacturers in the program. It provides the general framework from which ERDA develops the Justification Data.

The proposed Criteria and legislation include a section which permits ERDA to change the Criteria at any time it considers appropriate and in the best interests of the project. ERDA officials said that this does not reflect any change in intent since similar wording is included in the existing criteria.

ERDA officials told us that technically they can change the Criteria without first obtaining Joint Committee approval. However, these officials told us that as a matter of practice they would not make any changes to the Criteria without first notifying the Joint Committee. These officials stated that, in any event, any significant changes in the Criteria would require a change in the Justification Data, which is required to be submitted in advance to the Joint Committee.

Justification Data

The Justification Data generally describes the arrangement for carrying out the CRBR project. This document includes the names of the participating parties, the general features of the proposed arrangement, a description of the proposed project, and the amount of the estimated cost to be incurred by ERDA and the participating parties. This document is the "basis for the arrangement" required under Section 106(b) of Public Law 91-273.

NEED FOR ERDA TO ESTABLISH CLEAR MANAGEMENT RESPONSIBILITY

In its letter dated March 10, 1975, to the Joint Committee ERDA stated that its proposed changes in project arrangements

> "* * * are necessary to clearly delineate the manner in which the Project will be managed in the future, in recognition of the major increase in governmental financial involvement and the need to establish a single-line, integrated project management organization."

In our opinion, the various documents submitted to the Joint Committee do not clearly delineate the manner in which the project will be managed, but rather contain ambiguous and seemingly inconsistent language regarding responsibilities and authorization for management.

Although the broad language proposed authorizes ERDA to enter into "such arrangements as it may deem appropriate" and thus permits ERDA to manage the project, the proposed revised authorization bill does not explicitly provide for management of the project by ERDA.

The bill analysis states

"* * * ERDA will have management responsibility for the Project commensurate with the large Government investment, but with due recognition of the meaningful participation and involvement of the manufacturing and utility industries through the making available to the Project of policy guidance, technical and management expertise, personnel, facilities and funds."

Other sections of the documents submitted to the Joint Committee indicate that PMC will continue to have a dominant role in project management. For example, the Justification Data states

"PMC will be authorized to manage the project, subject to assignment of management responsibility to ERDA as deemed appropriate by it (ERDA) commensurate with the degree of ERDA's financial participation and risk, and PMC's role will thereupon change from project manager to utility liaison and general project overview."

The bill analysis states in part that while ERDA would assume the responsibility of managing the Project, it would also

"* * * under contract with PMC, obligate itself (a) to manage and carry out the Project in an efficient and effective manner consistent with Project objectives and (b) to design and build the plant substantially in conformance with the presently approved reference design and specifications."

In addition, the bill analysis states that PMC will administer the utilities' interests in the project, including "approving any proposed major changes in Project scope or deviation from the approved reference design or specifications." ERDA officials told us that the four-party contract will be modified to define major changes as any changes which could reasonably be expected to (1) increase or decrease the estimated project cost by $25 million or more, (2) increase or decrease the current estimated project schedules by 1 year or more, or (3) otherwise specifically jeopardize the probability of achieving any of the principle project objectives.

The bill analysis and Justification Data state that ERDA could make major deviations to the approved reference design, but that PMC or the other parties (TVA, BRC, and CE) would be entitled to invoke the Project termination procedures solely because they did not agree with the deviation.

The bill analysis states, in part, that

"* * * the present mechanism for reviewing disputed Project decisions would remain with the exception that ERDA would have final decisional authority in Project matters, provided that such decisions are consistent with Project objectives and the contractual rights and obligations of the parties, including the rights of PMC to approve any major change in Project scope or deviation from the reference design or specifications." (Underscoring supplied.)

Although the bill analysis explicitly gives ERDA "final decisional authority," it appears to limit ERDA's right to proceed with the Project work. We were told by an ERDA official that PMC's approval rights are intended to refer only to PMC's right to invoke termination procedures if a major deviation from the approved reference design or specifications is involved. However, since the proposed new termination criterion refers only to a design change and not to a major change in project scope, it appears from this language that ERDA's "final decisional authority" cannot be exercised to effect major changes without PMC approval and that under the threat of invoking termination procedures ERDA could be effectively precluded from proceeding with the project on the basis of a design change with which PMC disagreed. ERDA officials told us, however, that the modification to the four-party contract will explicitly provide that ERDA can proceed with the project work during the course of termination procedures. They also told us that the private participants have agreed to include this provision in the modified contract. In addition to having the right to approve major changes in the scope of the project and to invoke termination proceedings, PMC would also, pursuant to the Justification Data, have the right to "enter into project contract commitments as appropriate." In our view, the provisions regarding management responsibility, including PMC's right to enter into project contract commitments, in the bill analysis and Justification Data are inconsistent. Such inconsistencies suggest to us that ERDA will not be able to exercise the usual management prerogatives in the areas of design and other changes and that it may be subject to restraints in other management areas.

We discussed these inconsistencies with ERDA officials and they told us that, although they believe the documents are clear, ERDA will revise the documents to state that ERDA will manage the project. ERDA officials stated also that the revised four-party contract would clearly state that ERDA will manage the project.

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FUNDING AUTHORIZATION
REQUESTED BY ERDA THROUGH
THE PROPOSED CHANGES

The proposed legislation, which will amend Section 106(a) of Public Law 91-273, provides the following authorization for the project:

> "* * * $181,500,000 is hereby authorized to be appropriated to the ERDA for continuing the research and development, engineering, design, construction and testing of this demonstration power plant during FY 1976 and the Transition Period (July 1, 1976 - September 30, 1976), all of such sums, including those heretofore authorized, to be available for use in accordance with the hereinabove mentioned criteria as amended, together with such additional appropriations as may be necessary and sufficient for its operation for a period not to exceed 5 years."

In addition to this proposed legislation, an attachment to the Justification Data presents the current estimate of the Government's share ($1.468 billion) of the total estimated project cost ($1.736 billion).

ERDA officials expressed their belief that the Government's share of the total project cost is now authorized under Public Law 91-273 and that the proposed legislation would continue such authorization by virtue of the Justification Data lying before the Joint Committee for 45 days, unless the Joint Committee specifically disapproves this action. Thus, ERDA's position is that it was not before, and would not be in the future, required to seek authorization on an annual basis from the Joint Committee but that it could directly seek appropriations. ERDA officials told us that the intent of the proposed legislation is to allocate an amount from the total project funding authorization needed for fiscal year 1976 plus the 3-month transition period.

It is not clear to us that the Government's share of the total project cost is now or will continue to be authorized by virtue of the Justification Data lying before the Joint Committee for 45 days, unless rejected. The history of the legislation authorizing the project does not, in our view, clearly support the conclusion that ERDA's total project cost can be authorized in this manner. We believe it important to point out, however, that ERDA believes it now has and will continue to have authorization for the total Government cost of project participation, even though the proposed revision to the legislation does not include this amount.

In our view the Joint Committee should clarify (1) whether pursuant to section 106(b) of Public Law 91-273, as amended, ERDA can obtain authorization for the total estimated cost of the project by virtue of the Justification Data lying before the Joint Committee for 45 days and (2) whether the proposed legislation would authorize appropriations for fiscal year 1976 and the transition period or rather allocate for that period sums already authorized.

According to ERDA officials, the language in the bill for authorizing appropriations as necessary for a 5-year demonstration period was included to be consistent with the manner in which the project was originally authorized and to provide a clear indication to the Congress and the utility participants that it is intended that the plant operate once it is built and that funds could be anticipated to be appropriated in the future for such purpose. ERDA officials believe that without this indication the utility participants not only could but might very well, invoke the termination procedures and end their involvement in the project.

ADDITIONAL TERMINATION CRITERION

The existing four-party contract permits the project participants to begin termination proceedings if one or more of specified termination criteria are met. A provision in the proposed Justification Data would add another termination criterion, which is a failure by the project participants to agree on significant changes in the currently approved reference design. According to ERDA officials, this criterion is being added because the utility participants want to insure that the project will either be built in accordance with the current design or have an option to withdraw.

In this regard, a currently unresolved issue is whether the CRBR is designed so that it can acceptably accommodate the consequences of a core disruptive accident. The Nuclear Regulatory Commission believes that such an accident, although unlikely, is within the realm of possibility and should be provided for in the design of the CRBR. Accommodation of a core disruptive accident, according to the Nuclear Regulatory Commission, may necessitate additional features, such as a core catcher[1]. The current reference design does not have a provision for a core catcher. ERDA has started work on an alternate CRBR design which includes a core catcher in the event that ongoing research and development fails to show that a core catcher is not needed.

There are very strong indications that the utility participants are opposed to including a core catcher in the CRBR design. If Nuclear Regulatory Commission rulings bring about a requirement for a core catcher to be added to the CRBR design, the proposed additional termination criterion would permit the utility companies to begin termination proceedings.

ERDA officials told us that if a core catcher must be added to the CRBR it would not necessarily render the LMFBR concept uneconomical. However, ERDA is proposing to permit the private project participants the option to begin termination proceedings if there is a major deviation in project design, which the core catcher would be. Termination of utility participation in the CRBR would lead to termination of the four-party contract. ERDA could continue with the project without the utilities. However, if ERDA did not, the viability of the LMFBR concept would not be demonstrated in this country. The possible consequences of a decision by the Nuclear Regulatory Commission that could make a core catcher necessary could place tremendous pressure on this regulatory agency in arriving at a decision.

Moreover, the basis for permitting termination of private participation in the project, with its potential consequences, for a design change that (1) is brought about by a decision of the Nuclear Regulatory Commission over which ERDA, of course, has no control and (2) would make the CRBR plant licenseable--which is a major objective of the CRBR project--is unclear to us. It may be desirable for the Joint Committee to pursue with ERDA the need for this additional termination criterion.

UTILITY LIABILITY UPON PROJECT TERMINATION

The utilities' total pledges of more than $250 million are to be collected and remitted for project use in 10 annual $25 million installments.

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[1]A core catcher is a device located below or within the reactor vessel which, in the event of a core disruptive accident, will spread out the core debris. This would prevent material from reforming into a mass capable of a chain reaction and prevent core residue from melting through the bottom of the reactor.

Under the current Justification Data, if the project terminates, the utilities would pay 50 percent of the obligations incurred on the project up to the limit of the utilities' total pledges. Consequently, if the project terminated in 1976, for example, the utility pledges to be collected in 1977 and later could have been collected and used to pay project obligations up to and including termination. Also, utility pledges could be used as collateral for project loans.

Under the proposed Justification Data, only those utility pledges collected and due in the year the project terminates would be used to pay project obligations. In addition, utility pledges would not be available for use as collateral for project loans.

According to ERDA officials, these proposed changes are viewed by ERDA and the private participants in the project as necessary revisions to reflect the proposed management structure.

PAYMENT OF MANAGEMENT FEES TO REACTOR MANUFACTURERS INVOLVED IN THE CRBR PROJECT

Three reactor manufacturers are involved in the CRBR project. Westinghouse Electric Corporation is the lead reactor manufacturer and General Electric Corporation and Atomics International--a division of Rockwell International--are subcontractors to Westinghouse. Under the current arrangements, management fees (profit) can be paid to all three CRBR reactor manufacturers for work financed under the base program or by utility contributions. However, management fees cannot be paid to the lead reactor manufacturer out of the $92 million in direct assistance funds. ERDA officials told us that the reason for this is twofold:

--AEC traditionally had not paid fees to reactor manufacturers in cooperative demonstration programs.

--AEC had anticipated, under the existing Criteria, awarding a contract to one reactor manufacturer who would have overall management responsibility for the CRBR project. That manufacturer would have a decided advantage over the remainder of the nuclear industry. AEC concluded, then, that the selected reactor manufacturer should not be entitled to a fee over and above the benefit he would receive by virtue of his participation in the program.

ERDA now proposes, through a change in the Criteria, to pay the CRBR reactor manufacturers appropriate management fees for all work performed for the project. ERDA contends that a fee is now defensible because the situation anticipated by the original Criteria did not materialize. An exclusive cooperative management relationship with a single reactor manufacturer was not realized and a general involvement of the three major reactor manufacturers in the CRBR project has evolved. As such, ERDA officials believe that it would be unrealistic and unreasonable to expect these manufacturers to commit themselves to such an extensive program simply for reimbursement of costs.

Payment of fees for work already performed

The proposed Criteria, says ERDA, would give ERDA the authority to negotiate and pay fees for work already performed. The ERDA officials said that they do not intend to pay fees to the lead reactor manufacturer but do intend to pay fees to the two major program subcontractors for work already performed. ERDA has already negotiated fees with the two major subcontractors, assuming affirmative action of the Joint Committee on the proposed legislation and other documents.

ERDA officials said that the lead reactor manufacturer, by virtue of its lead management role, probably has benefited more from the past arrangement than the subcontractors and therefore should not be entitled to a fee for work already performed. We pointed out to ERDA officials that the lead reactor manufacturer will continue in a lead management role in the future. ERDA officials said that they recognized this and indicated that any future negotiated fixed fees with the lead reactor manufacturer would be negotiated so as to reflect their degree of benefit.

ACCESS TO RECORDS CLAUSE

The PMC contracts with Westinghouse as lead reactor manufacturer and Burns & Roe as architect-engineer stipulate that the Comptroller General (or his duly authorized representative) shall have access to the pertinent records of Westinghouse and Burns & Roe. Moreover, the original contracts required both Westinghouse and Burns & Roe to insert in their subcontracts a Comptroller General examination of records clause. However, in late March 1975, the Westinghouse and Burns & Roe contracts were amended by PMC to delete the requirement for a Comptroller General access clause. ERDA explained that this was done because General Electric--a prospective subcontractor to Burns & Roe--refused to include this access to records clause in any contract it executes with Burns & Roe. There is no statutory requirement to include an examination of records clause in a second-tier subcontract such as the one between Burns & Roe and General Electric.

In August 1974, a letter of intent to purchase a turbine generator was signed by PMC and General Electric. On March 31, 1975, Burns & Roe awarded a fixed-price contract to General Electric, as a second-tier subcontractor, for a turbine generator for the CRBR. This contract did not contain clauses permitting either ERDA or the Comptroller General access to General Electric's records.

According to ERDA officials, there are only two contractors in the United States which have the capability to supply the turbine generator, and both submitted offers which were negotiated to an acceptable price. Also, according to ERDA officials, commercial components of both contractors refused to include access to records clauses in their contracts. Accordingly, there will be no opportunity for determining, on the basis of contractor records, whether the most reasonable price was negotiated.

REQUEST FOR STATUTORY EXEMPTIONS

The proposed legislation would authorize ERDA "to utilize personnel, facilities and funds" of reactor manufacturers, utilities, and others "without regard to any contrary provisions of law." ERDA officials told us that this provision is designed in part to permit industry and Government personnel to work together in a single, integrated management organization without regard to existing legal restrictions on the Government's use of contractor personnel.

ERDA officials told us that they expect this single, integrated organization to have a staff of about 100 people. No restrictions or limitations have been established in any of the documents submitted to the Joint Committee on the number of staff of this organization that could be affiliated with the utilities. The bill analysis indicates that the three-member project steering committee (consisting of a representative from CE, TVA, and ERDA) will have the right to identify key positions in this integrated organization for individuals from PMC. The documents submitted to the Joint Committee do not specify how disagreements would be resolved among the project steering committee members on this right. Also, these documents are silent as to the affiliation of the head of this organization.

ERDA's Director of Reactor Research told us that the individual heading up the project organization would be an

ERDA employee. He also told us that, if there are any disagreements, ERDA intends to make all final decisions regarding key positions in the organization and that non-Government individuals would be used in various parts of the integrated organization. Personnel from the utilities, he said, are expected to be in the policy decision chain only in those areas relating to the non-nuclear portion of the plant.

With respect to ERDA's request to utilize the funds and facilities of reactor manufacturers, utilities, and others without regard to any contrary provisions of law, an ERDA official told us that it is ERDA's intent to obtain, through this revised section of the authorization, the flexibility to use funds and facilities contributed by the private sector in any manner it considers in the best interest of the Project.

Under 5 U.S.C. 2105(a), as that section has been interpreted by GAO and the courts, contractual arrangements pursuant to which non-Government personnel performing Governmental functions are subject to supervision of Federal employees are regarded as creating an employer-employee relationship regardless of the actual intent of the parties. Therefore, to the extent that industry personnel would be directly supervised by ERDA employees under the proposed integrated organization, such personnel would be regarded as temporary Government employees. As such, in the absence of the proposed statutory exemption, they would be subject to a wide range of personnel laws dealing with such areas as appointment, classification, promotion, leave, travel, non-discrimination, and conflict of interest. Even if ERDA is able to establish the integrated management team in such a way so that the industry personnel are regarded as independent contractors rather than as Government employees, the proposed statutory language would still exempt the arrangement from laws pertaining to public contracts (e.g., minimum health and safety standards, non-discrimination, etc.) that would otherwise be applicable.

We are concerned over the broad language of the proposed legislation. ERDA has not explained why it would be desirable to have a blanket exemption from all personnel laws, as opposed to certain specified ones, or from all laws applicable to ERDA contracts. On the basis of ERDA's explanation of its intentions regarding the integrated organization, it does not appear to us that an all-encompassing exemption from existing statutory requirements is warranted. We believe ERDA should be required to include in its supporting documents a clear statement of its plans with respect to this matter together with the specific legislative exemptions deemed necessary by ERDA to enter into the proposed revised arrangement.

Furthermore, we believe that clarification is needed as to the affiliation of the head of the proposed integrated organization and as to the rights of both ERDA and this head to control and staff this organization.

OTHER MATTERS TO BE CONSIDERED

The proposed Justification Data does not clearly identify the basis for determining

--the price that TVA will pay for the energy produced by the CRBR plant during the demonstration phase,

--the value of the CRBR plant which TVA will have an option to buy from ERDA after the demonstration period is over,

--the procedures for resolving disagreements among the four parties, and

--the rights of ERDA to inspect contractor records during the demonstration-operation phase of the project.

ERDA officials told us that those provisions of the four-party contract which specify the basis for determining the above items will not be changed as a result of the modifications to the four-party contract.

Mr. STAATS. Congressman Brown, that was one of the principal things we emphasized in the procurement report; namely, getting a good program manager and giving him responsibility and letting him work out the interface with industry and the contractors.

Representative BROWN of Ohio. Your answer, in general, is that you think there is enough on the books or that could be put on the books to take care of these problems?

Mr. STAATS. I think so. But, to underscore again the importance of taking them pretty much case by case, Mr. Brown, that should be done, because we think it is awfully hard to generalize.

Mr. HUGHES. Mr. Brown, I think there is a more or less specific procurement recommendation the essence of which is, with respect to this sort of a program, "Don't do it." You know, "Don't do it this way;"—that is concurrently—which leaves one at sea if it is in the national interest to proceed this way. What the Commission is saying, as I read the report—and I think my recollection is accurate—is that going concurrently with respect to the R. & D., pilot development, and the commercial development trends—well, you don't have all the information when you start and, therefore, you run into problems as you go, and those problems have profound effects on cost estimation, on the need for change, and so on.

This project is proceeding on a concurrent basis and we are starting to design the Clinch River plant. Some of the ultimate features of that design are still in a very debatable stage, like this business of core melt-down safeguards and the so-called core catcher, which is a very important feature costing tens of millions of dollars. The answer may evolve in the next year or two or three or may still be debated at that point.

But, going concurrently in proceeding with the development of a complex energy system like this is inherently subject to all kinds of changes and evolutionary developments, which affect costs and ultimate design of the product.

Representative BROWN of Ohio. The best chance we have of getting taken as taxpayers is if it is an experimental program that is sort of developing its own rules as it goes along. And further, from what you said, I guess there is an even better chance if a program is run by a committee, because that has sort of a shiftable responsibility or mobile responsibility with changing leadership. I must say that experience has certainly been borne out by the experience of the U.S. Congress.

Mr. HUGHES. Clearly there has been a national decision that this concurrent development is necessary because of the energy needs of the Nation, and there are time factors here that drive us, but obviously there are tremendous costs.

Representative BROWN of Ohio. Mr. Chairman, in conclusion I would suggest that maybe what we need on such new programs is somebody on each such program—not perhaps a scientifically sophisticated man, but an efficiency expert who would just say, "Hey, wait a minute. If you are going to make that change, what is it going to cost?"

We need somebody who will always ask what is it going to cost and whether the decision is going to produce a beneficial result. We need some kind of oversight individual. And I don't know where we would place such a person, but it might be appropriate to put them in on a regular basis when we get into such new programs just simply to be hard to get along with.

Mr. STAATS. That is correct. You need someone at a high enough level in the organization that has to make that decision of whether you go forward with a change or not. Now, the Defense Department has set up a Defense Systems Acquisition Review Council, which is made up of top people at the Pentagon. These judgments have to come to that Council, which is advisory to the Secretary, before they are made.

Chairman HUMPHREY. I have a series of questions I would like short and brief answers to to complete the record with GAO this morning.

Mr. Hughes, you said that moderation in electricity demand appears to be permanent. If this is correct, is a stretchout of the breeder program, in your estimation, justified?

Mr. HUGHES. I think the answer really follows from the assumption, Mr. Chairman. If demand is down below the levels upon which the need for the breeder was predicated, then, yes, a slowdown will enable the breeder to be online and to be commercially feasible with enough commercial plants produced to meet the energy needs of the country. But, this demand business is a speculative business.

Chairman HUMPHREY. Mr. Staats, would you agree with the EPA that a delay in the program—and as you know, EPA did recommend a delay of anywhere from 4 to 12 years—that a delay would not seriously decrease the projected benefits of the program, while giving more time to deal with some of the serious uncertainties?

Mr. STAATS. It was my understanding they did not recommend a delay as such. Maybe it is the other way around, where they said that, if the program were to be delayed for that period of time, presumably it would not create great difficulties because of the decrease in demand.

Chairman HUMPHREY. Well, they will be up here to testify next, but the Environmental Protection Agency did suggest the Government slow the development for plutonium breeding nuclear reactors on which many utilities have based their plans—and I am reading from a story from the New York Times of April 28—and it suggested a delay of from 4 to 12 years, based on findings that, in sponsoring the breeder, the Atomic Energy Commission had apparently everstated the problem and growth rate of electrical power demand.

Mr. HUGHES. For whatever it is worth, Mr. Chairman, I just happen to have the EPA report here upon which that news article was based. I think that report says it a little differently, but it is a rather important difference.

It says:

> Using the latest demand projections of Project Independence, our preliminary analysis indicates that a delay of 4 to 12 years might be accommodated without significantly reducing the uranium conservation value of the breeder. This should not be construed as indicating that EPA is necessarily advocating delay, but that sufficient evidence exists to warrant reexamination of LMFBR timing assumptions.

Chairman HUMPHREY. Do you agree with that statement?

Mr. HUGHES. I do.

Chairman HUMPHREY. OK, I just wanted to get a few things on the record here.

Mr. Staats, again, you or any member of your staff can answer. You state in your report that, according to ERDA, the breeder reactor will not be viable commercially without an efficient fuel reprocessing cycle and this technology is still at the laboratory stage and probably the least advanced aspect of the program at this time.

Also the Nuclear Regulatory Commission is only now considering now whether it will be safe to recycle plutonium. In view of this, does it make sense, in your judgment, to go ahead with an expensive demonstration plant when this critical component of the whole package is still subject to this uncertainty?

I would like a yes or no, but whatever you wish to say.

Mr. HUGHES. I will take a run at it, Mr. Chairman. I think the answer is, "Yes," it does make sense to proceed on some schedule or other, subject to the time considerations we were just talking about. It does make sense to proceed with a demonstration plant. One of the purposes of the plant is to explore, to test in a commercial environment and in a power-producing environment the kinds of concerns that the public has and that the scientific community has about plutonium recycling.

Chairman HUMPHREY. So your general judgment is that there should be at least a scheduled program of development, even though the uncertainties are there about the plutonium?

Mr. HUGHES. That is certainly my answer.

Mr. STAATS. Yes.

Chairman HUMPHREY. Mr. Carlone and Mr. Eschwege?

Mr. CARLONE. Yes.

Chairman HUMPHREY. Is that your judgment Mr. Eschwege?

Mr. ESCHWEGE. Yes.

Chairman HUMPHREY. You also point out in your report that it will be necessary for the Government to continue to subsidize breeder powerplants until they are competitive with light-water reactors. This smacks of some open-ended commitment.

What is your best estimates of the level of Government subsidies that will be required for the breeder program, or don't you want to get into such estimates?

Mr. CARLONE. We don't have our own estimate, Mr. Chairman. We found that the range is somewhere from the $300 million that are included in the $10.7 billion estimate by ERDA to other studies that put this figure around $2 billion. We tried to give an indication in our report of this range.

Chairman HUMPHREY. Mr. Carlone, a great deal of money is being spent on refinements of the engineering necessary for an ideal design of the breeder reactor, but not necessarily for a commercially efficient one. For instance, I understand that the AEC is attempting to produce the perfect design by requiring the reactor to operate at very high temperatures, and that, it therefore, must contain new heat-resistant materials that are being developed at great costs. Reportedly, little would be lost by operating at lower temperatures with existing materials. After all, the purpose of this project is to earn its way in the commercial world.

Has the GAO attempted to find out whether the design itself is cognizant of economic restraints? In other words, is it necessary to develop the perfect laboratory project when possibly something else would suffice?

Mr. CARLONE. We have not looked into the design. As I pointed out earlier, it has been over the last year that the design has become more finalized. This may be the subject of future inquiries, but we have not looked at it yet.

Chairman HUMPHREY. I think you would want to take a look at that question again. My point is that the AEC attempts to produce the perfect design and that this brings in many new requirements that would not necessarily be essential for a commercially operating plant. We are really talking about something not for the theorists, but for the consumers.

Mr. STAATS. Let us think about this further.

Chairman HUMPHREY. I have a couple of other questions here. The next complete breeder would be called the so-called near commercial breeder reactor, costing perhaps $2 billion. The Government would pay about 15 percent with industry paying $1.7 billion; a staggering sum, and they would supposedly start committing money in 1977. Now this is the scenario that has been given to us in terms of the overall development of the breeder reactor. The proposed breeder development schedule involves first the small demonstration reactor at Clinch River, which would begin operation in 1982. The next breeder would be the so-called near commercial reactor, which would cost about $2 billion.

The Government, according to that development schedule, would pay 15 percent for the follow-on project and private industry would pay the balance of $1.7 billion. But, Mr. Leonard Cocklin of the Illinois Power Co. was quoted in Nuclear News as saying, "There is a significant lack of interest as to the Clinch River project amongst utility people. In fact, they are not even discussing it."

In view of the enormous sum involved, and in view of the fact that the private companies must start paying for the near commercial breeder before the technology from Clinch River is even proven, and in view of their exclusion from Clinch River management last month, and in view of the lack of interest which is stated about the Clinch River project, what is the likelihood we will ever get private utilities to contribute $1.7 billion to the near commercial breeder?

Mr. HUGHES. Mr. Chairman, they need the energy source. I think that is the short answer. Some way or other, utilities need a fuel source to provide the steam to drive turbines to produce electricity, and electrical needs are growing in any event. There are alternative sources of energy, obviously, but most of them, for one reason or another—economic, environmental considerations, vulnerability to interruption as in the case of the Mideast oil—have their drawbacks.

Therefore, there is a community of interest, it seems to me, between the Government and the utility industry in something like the breeder reactor. If you talk to some utility people, not Mr. Cocklin, I gather, but to some of them, they see distinct advantages for them in having a long lasting, uninterruptible source of fuel for driving their machinery to produce electricity. The breeder, if it works right, and if the recycling process works right—and so on, is virtually uninterruptable. It is a compact fuel supply. The use of fuel, which can be used in turn to make more fuel, makes transportation no problem; and neither is mining.

Mr. STAATS. If I could just add to that? This involves the economics of using uranium, you see—with a light-water reactor you get only about 2 percent of the potential energy from the fuel; under the breeder potential you get about 60 percent. It looks pretty good, particularly in view of the uncertainties of the availability of the raw materials.

What our reserves are is still a highly speculative matter, Senator, but if you look at an investment of the type that goes into a nuclear powerplant, you have to be reasonably certain you are going to have fuel over the life of that plant to operate it.

The other point I would like to emphasize, and this goes back a little to the European experience, is the concern we have seen from the utility people about whether this is going to be produced within the competitive range, even given the difficulties of alternative sources of energy. So, the great question here is now you can get this done at the lowest possible cost.

Chairman HUMPHREY. I see your point. My point was that the private utilities would have to start committing money in 1977, and the Clinch River isn't even going to be in operation until 1982. Mr. Cocklin may be unique in his doubts, but I think it would be interesting to find out, if there is any way we could, what the general attitude is in the utility industry. As Mr. Brown was saying to me, given the current capital needs and the fact that there is a profit squeeze and in many places a simple lack of profit, given that, I think we might want to take a look at it and maybe ask you to do more than you have done at this time.

I am about through here. We want to get the EPA people up here.

My last question is on the uranium supplies cost. Uranium prices today are $15 or $20 per pound and are up from $8 to $10 a pound a year ago, as I understand it. Assuming oil prices at $10 per barrel, how high could the price of uranium go and still be economic?

Mr. HUGHES. We don't have a specific answer for you, Mr. Chairman. We will deal with that question with some comparative analysis of fuel prices in the issue paper which we will have in the next month or so.

Chairman HUMPHREY. Our staff indicates here the figure would be in excess of $200 per pound with the generating power from light-water reactors, but I want that checked out.

The main question is the available supply of uranium, and some people think the AEC estimates are rather conservative. They are limited to deposits, to shallow deposits, and to regions of known uranium occurrence. The AEC inferred a future uranium shortage by earmarking enough fuel for each reactor's entire lifetime in advance of its construction and allowing no additional discoveries during its 40 years of operation. The AEC seems not to take cognizance of foreign ores or of potential technological progress, such as laser enrichment techniques.

So, here we have a situation where interest in the breeder reactor has been based in part upon what are the allegedly limited supplies of uranium material. There is a big argument in the mining community and the scientific community as to whether or not, if you got a higher price for uranium, whether you could go much deeper than the current mining operations. Of course, that has some environmental problems with it.

In your May paper, or your later paper, I wish you would give some thought to that. I am going to ask the staff to make that inquiry slightly more precise than I have it here. I just wanted to toss it out as one of the areas of concern.

I find the Wall Street Journal indicates in an article dated April 25th that we are now exporting uranium to Russia for processing for resale to European utilities. The major rationale, of course, for needing the breeder reactor is that we are rapidly depleting our uranium reserves and we must, therefore, develop a commercial breeder before we deplete these reserves. Here we are exporting it to the Soviet Union.

How much uranium of the total mined domestically is destined for export? Does anybody know? Let's try to find out. How much of the world's reactor fuel uranium does the United States supply and what long-term commitments, if any, have we made to sell uranium abroad in the future? All of this seems to be inconsistent with one of the rationales for the breeder reactor; namely, that uranium is going to be in short supply. We've got an export policy which is contrary to what we might call our self-serving national interest of conserving our uranium resources. So if you would take a look at it, that would be helpful.

Gentlemen, I had a few other questions, but we have the EPA here. If you will permit me, Mr. Staats, I will ask the staff to go over this testimony and go over some of the questions we had prepared and didn't ask, and we will send some questions over to your office and possibly you can give us a written response. We won't overburden you with it.

Mr. STAATS. It occurs to me if we don't have these when we correct the record, we will try to take them into account in the issue paper.

Chairman HUMPHREY. I am very grateful to you, again, for appearing here today.

Our next witness is Mr. Sheldon Meyer, Director of the Office of Federal Activities, Environmental Protection Agency.

Mr. Meyers, we welcome you here and thank you for your patience this morning. I hope the discussion that preceded this may be of help to you in directing your commentary to this record of this committee.

You are the Director of the Office of Federal Activities of the Environmental Protection Agency, am I correct? You have a full statement here. Would you like to read it or paraphrase it, or how do you wish to proceed?

STATEMENT OF SHELDON MEYERS, DIRECTOR, OFFICE OF FEDERAL ACTIVITIES, ENVIRONMENTAL PROTECTION AGENCY

Mr. MEYERS. I have a prepared statement I would like to read.

Chairman HUMPHREY. All right. Just go right ahead.

Mr. MEYERS. I want to convey Mr. Train's regrets for not being able to be here this morning.

Chairman HUMPHREY. No; it's all right. We are happy to have you here. You are a man of competence. Go right ahead.

Mr. MEYERS. I appreciate the opportunity to appear on behalf of the Environmental Protection Agency to discuss various aspects of the liquid metal fast breeder reactor (LMFBR) program.

As you are aware, our needs for new and more abundant supplies of energy resources are intertwined with our needs to assure that important environmental values are protected. For this Nation to achieve these goals, comprehensive analysis of alternative energy sources will require assessments of the impacts in social, economic, and environmental areas.

Let me say at the outset that EPA is not opposed to the LMFBR concept. However, in pursuing this program it is important that we not prematurely close the door to other energy alternatives.

EPA has recently completed its review of the Atomic Energy Commission's proposed final environmental statement on the LMFBR program. Copies of our comments on this statement have been provided to the committee.

In my testimony this morning I would like to discuss briefly some of those comments.

SAFETY

In our review of the March 14, 1974, draft environmental statement for the LMFBR program, we were unable to conclude that the environmental impact of the LMFBR program would be minimal, nor could we determine the approaches that would be taken to insure satisfactory resolution of important safety questions. Our comments on the draft statement were intended to reflect NEPA requirements which were emphasized in the court decision on the LMFBR program draft statement; that is, it should "... indicate the extent to which environmental effects are essentially unknown."

Based on our review of the proposed final statement, it is apparent that the AEC staff expended considerable effort in attempting to address the safety-related issues previously raised. We commend their efforts, recognizing that development of much of the detailed information was impossible at this state of the program. While we concur with the general commitments and approach toward insuring safety as indicated in the proposed final statement, the specific safety problems, their expected solutions, and the projected environmental impacts must eventually be publicly detailed and reviewed.

As you know, the Nuclear Regulatory Commission, under its licensing program, has responsibility for and is reviewing safety problems and will pass judgment on them in a public forum.

In our opinion, more design, and performance data, and analyses are required before the risks of the LMFBR can be evaluated. If possible, the anticipated ERDA final statement should provide more amplification on this program effort including the presently limiting factors—information, technical detail, development work, et cetera—and the anticipated time frame for the completion of the risk analyses.

TRANSPORTATION SAFETY

The proposed final statement does not provide the basis for quantification of the risks associated with transportation accidents; rather, risk values were based on assumptions and judgments. To our knowledge, the relationship has not been established between LMFBR materials packaging test requirements and the physical integrity of such packages under various accident conditions. As a result, transportation risks have also not been established.

PLUTONIUM TOXICITY

The proposed final statement recognizes that with respect to plutonium toxicity the answers to some important questions concerning the impact on public health are not available. AEC and EPA recognize that in many cases there are reasonable differences of opinion on the health implications that might be inferred, particularly in the absence of definitive data.

While it is agreed that animal toxicity experiments (and not the meager human exposure data) should serve as a guide, the discussion of animal data is not sufficient to allow a judgment to be made on plutonium toxicity in man. The differences of opinion on the significance of animal data extrapolated to man are unresolved.

Although the toxicity of plutonium may be underestimated by an order of magnitude, adjusting the adverse health effects estimates upward by an order of magnitude would not significantly change the total health impact of the LMFBR program as estimated by the AEC in the proposed final statement. This is because the projected releases of plutonium are so small.

Chairman HUMPHREY. Now what the devil does that mean?

Mr. MEYERS. The next sentence explains it.

Chairman HUMPHREY. You know some of these sentences just confuse me. I thought I was an educated man, but I don't know. I can't figure some of these things out.

Mr. MEYERS. This is because of the relatively insignificant emissions of plutonium in the first place.

Chairman HUMPHREY. Well, that is what we are getting at.

Mr. MEYERS. Yes, and this explains it. As new data become available during the development of this technology, any significant changes that may occur in the assumed probability and magniture of plutonium releases into the environment from LMFBR fuel cycle would require a reevaluation on the health impacts due to the LMFBR program.

Health effects have been forecast on the basis of what is essentially a zero release operating philosophy. It is not yet possible to say whether near zero release is technologically possible or whether all important plutonium releases, such as those due to sabotage, have been properly considered.

RADIOACTIVE WASTE DISPOSAL

In the proposed final statement the AEC stated that ". . . to date, there have been no reports of migration of radioactive material from commercial burial sites." We would note, however, that radioactivity has been reported to have migrated offsite from burial facilities in Kentucky and New York State. These two sites were initially licensed under the assumption that they would contain the wastes buried therein for hundreds and even thousands of years.

The reported results of an investigation by the Kentucky Department for Human Resources clearly indicate that the radioactive waste disposal site on Maxey Flats is contributing radioactivity to the environment. Recent reported findings by the New York State Department of Environmental Conservation have also shown radioactivity levels in surface runoff from the Nuclear Fuel Services burial site near West Valley, N.Y.

Additional environmental studies supported by EPA, in cooperation with the Kentucky Department for Human Resources, support that department's findings, and studies of the site hydrogeology by the U.S. Geological Survey have identified pathways and mechanisms for this offsite movement of radioactive materials.

Chairman HUMPHREY. When this was discovered, did you tell the AEC that they are offbase, or do we just pass nice notes between agencies of Government? Who is telling whom what?

Mr. MEYERS. We have indeed conveyed our feelings and——

Chairman HUMPHREY. What do you do about it after you have conveyed your feelings?

Mr. MEYERS. We have undertaken, as I understand it, studies with New York State and Kentucky to more clearly what is happening.

Chairman HUMPHREY. You say here that your findings are showing that radioactivity emissions and runoffs really take place?

Mr. MEYERS. We are trying to pinpoint where the problem is.

Chairman HUMPHREY. But, you are saying it does happen. But you say here AEC stated that: "To date, there have been no reports of migration of radioactive material from commercial burial sites." It is the same Government, isn't it?

Mr. MEYERS. Yes, sir.

Chairman HUMPHREY. Who is running the show? I mean, are you in charge or are they?

Mr. MEYERS. The program, as you know, is run by the AEC. We have a monitoring responsibility. In executing this responsibility and in conjunction with the two States mentioned, we have apparently found releases of radioactivity. We have brought this to the attention of the AEC. We are trying to define what the problem is. When we have defined it, we will ask that it be corrected.

Chairman HUMPHREY. You know, if this happened with a private company, you would put them out of business, don't you?

Mr. MEYERS. I can't answer that, sir.

Chairman HUMPHREY. But you do. You get an injunction. You get a court order on it. I have seen it happen in my State. Why don't you get a court order against the AEC? Who are they? Are they better than the Reserve Mining Co. in Minnesota, for example? Don't misunderstand me now. I know that Reserve Mining has been polluting Lake Superior. We had a district court that ruled to that effect, and the circuit court gave them a little time to shape up. What are you doing about shaping up the AEC's polluting operations?

Mr. MEYERS. I might add the court didn't order them to shut down.

Chairman HUMPHREY. Yes; but they will have to spend quite a bit of money to fix this thing up. Again, I am not arguing about the decision. Don't misunderstand me there. I am sympathetic to the decision. I just want to know, do we play hanky-panky amongst the Federal agencies, or do you do to the Federal agencies what you do to the citizens of this country?

In other words, when a private company or private individual violates your standards, whammo, you come down on him and sometimes, I think, unduly so. But be that as it may, when it comes to the AEC, you say, "Brothers and sisters, let us sing two or three hymns together."

Mr. MEYERS. No; I don't think it is that way. Where we have identified problems, not only with the AEC but with other Federal agencies, and brought these problems to their attention, they do indeed correct them. Now, in this particular case, as I say, we are trying to pinpoint where the problem is. There have been measurements that would indicate there are releases. I am personally convinced that once those problems are identified, the AEC will correct them.

Chairman HUMPHREY. Good, and you give us the report when it happens. I want to find out when it happens, and soon.

But, I have great suspicion about how the agencies of Government work out their problems. I want the Government to treat their respective agencies like they treat my constituents. When you crack down on my constituents with the IRS or Justice Department or the FTC or somebody else, they cringe, and they are knocked right off the ledge. But, when you deal with each other, you go around violating laws day after day and year after year. You just slap their wrists and say, "Don't do that again; you're a bad boy."

OK, go ahead.

Mr. MEYERS. We believe that additional investigations are required to determine the ability of all of the present sites to comply with the criterion of no offsite migration. EPA is conducting investigations at the West Valley and Maxey Flats waste burial facilities in cooperation with State agencies and the U.S. Geological Survey. We have also reviewed available reports on investigations which have been conducted at the other four waste burial facilities.

We appreciate the AEC's effort in clarifying and reorganizing the classification of wastes is a matter of some concern to EPA. The category "other-than-high-level" wastes and its subcategories do not, in our opinion, give sufficient information as to the activity, content, and hazard potential of the waste.

A more detailed, explicit classification system is needed to enable reviewers to evaluate the potential environmental impact from the other-than-high-level wastes. Such a system would be of great assistance to EPA as well as burial site operators and the State agencies which regulate them.

PLUTONIUM SAFEGUARDS

We regard the safeguards program to be of utmost importance. Therefore, in order to avoid possible gaps in the development of that program, we recommend that the final statement indicate the specific areas of responsibility and authority for safeguards between ERDA and NRC. Further, it would be helpful to have the breakdown of responsibilities for safeguards within these agencies.

BENEFIT COST ANALYSIS

Our comments on the proposed final statement point out three areas where there are problems with the method of analysis and the presentation of the analytical results. These are: (1) The base energy demand projection; (2) the timing of the commercial introduction of the LMFBR; and (3) the uncertainty with respect to the possible benefits that may accrue from the LMFBR program.

With respect to the electrical energy demand projections, we believe that there is a likelihood that the base projections are high, in light of the Project Independence Report. As part of that report, FEA prepared base case projections for total energy demand as a function of the price of oil over the short-term period from 1972 to 1985. With the price of imported oil at $7 per barrel, total energy demand was projected to grow at 3.2 percent per year.

Chairman HUMPHREY. Where are you getting oil at $7 per barrel?

Mr. MEYERS. In this country, I believe; we are using these figures as——

Chairman HUMPHREY. You've got to be kidding here. You use this for a basis of comparison, but why do you want to compare things that don't exist? What is this nonsense about $7 per barrel?

Mr. MEYERS. The figure came from the Project Independence Report, I suppose it is possible for the price to drop down to that level some day.

Chairman HUMPHREY. You think so?

Mr. MEYERS. Not really, but it is possible.

Chairman HUMPHREY. I had a talk with Mr. Yamani from Saudi Arabia last week and——

Mr. MEYERS. What did he say?

Chairman HUMPHREY. I think you ought to visit with him. But, go ahead. I get your point here. You are making an analysis at $7 per barrel and then we have another one at $11 per barrel.

Mr. MEYERS. Right. However, with a price of $11 per barrel total energy demand was projected to grow at 2.7 percent per year.

Project Independence also projected a long-term "base case" total demand for energy. According to that projection, total energy consumption should grow at a rate of about 2.5 percent per year from 1985 through the year 2000.

The base case Project Independence projections for total energy demand can be compared to the proposed final statement base case projection by applying the above growth rates to that statement's 1970 estimate for actual demand.

The proposed final statement projection for electric energy demand assumed that 65 percent of the total energy demand in the year 2020 would be met by electric power generation. Applying the same assumption to the numbers derived from the Project Independence Report, one can derive comparable electric energy demands based on the Project Independence growth rates.

The results indicate that electric energy demand for the year 2020 will be 33 to 28 percent less than that projected by the proposed final statement base case, depending upon whether the price of an imported barrel of oil is $11 or $7 respectively.

Chairman HUMPHREY. I see. So in the best of times or the worst of times as far as energy demand is concerned, the electrical energy demand will be either 33 percent or 28 percent less, depending on whether you put it at $7 or $11 a barrel in oil equivalent?

Mr. MEYERS. In addition, it would also appear that the proposed final statement base projections are high in light of the projected rate of electrical demand related to the rate of population growth. Projections of total energy consumption and energy inputs to the electrical sector were made on the basis of their historical relationship to population growth. The apparent basis for the energy estimates was the E– series population projection of the Bureau of the Census equal to 0.81 percent growth per year.

Examination of the historical population and total energy demand data suggests that the total energy demand projections in the proposed final statement may not be consistent with the population projection.

During the period from 1950 to 1972 the U.S. population grew at an annual average rate of 1.45 percent per year. During that time, total energy demand grew at a rate of 3.4 percent. Therefore, it is not clear that it is appropriate to retain the high 3.4 percent rate of growth in energy demand while projecting the reduced 0.81 percent rate of growth in population, as has been done in the proposed final statement case forecast.

Were the same relationship between rates of population growth and energy demand over the 1950 to 1972 period to persist over the period from 1970 to 2020, one could expect on the basis of that relationship alone that the rate of growth in total energy demand associated with a 0.81 percent rate of population growth would be 1.9 percent per year instead of 3.4 percent.

With respect to the timing of commercialization of the LMFBR, and using the Project Independence figures cited above, we have carried out some preliminary analyses which indicate that the planned 1987 date for commercial introduction might be postponed 4 years, if the Project Independence base case projection for total energy demand with oil at $7 per barrel were realized. In addition, a 12-year postponement may be possible if the $11-per-barrel rate were to occur.

This and other evidence seems to indicate that a reexamination of LMFBR timing assumptions is warranted. If additional time is indeed available, a more flexible schedule might be adopted to accommodate potential changes in energy demand and environmental factors.

Finally, with respect to LMFBR program benefits, we believe that the proposed final statement places too much reliance on the base case forecasts to show the benefits of the program. One can infer from the AEC analysis of varying combinations of less optimistic conditions—with respect to growth of energy demand and LMFBR capital costs—that the projected net benefits of the program could be low or even negative. The final program and cost-benefit analysis should reflect such uncertainties.

We believe that the present plans for LMFBR research and development should be reexamined, allowing if possible for adjustments in scheduling or program changes. This may help reduce the possibility of negative benefits in the event that the anticipated conditions favorable to early commercialization of the LMFBR do not materialize.

Mr. Chairman, this concludes my remarks and I will be happy to answer any questions.

Chairman HUMPHREY. Thank you very much. I have a number of questions.

First of all, I want to include at this point in the record your letter of April 23 to Mr. Pennington, an assessment and coordination officer of the Division of Biomedical and Environmental Research of the Energy Research and Development Administration, along with the Environmental Protection Agency's comments on the proposed final environmental statement. It is to this report that you have alluded and referred?

Mr. MEYERS. That is right.

[The letter and statement follow:]

U.S. ENVIRONMENTAL PROTECTION AGENCY,
Washington, D.C., April 23, 1975.

Mr. W. H. PENNINGTON,
Assessment and Coordination Officer, Division of Biomedical and Environment Research, U.S. Energy Research and Development Administration, Washington, D.C.

DEAR MR. PENNINGTON: In accordance with our responsibilities under NEPA and Section 309 of the Clean Air Act, as amended, the Environmental Protection Agency has reviewed the Atomic Energy Commission's proposed final environmental statement (PFES) on the Liquid Metal Fast Breeder Reactor (LMFBR) Program (Wash-1535), issued January 16, 1975. Our enclosed detailed comments are offered for consideration prior to completion of the anticipated ERDA environmental statement on this program.

Environmental impact statements often include consideration of factors not strictly environmental, particularly to the extent that these factors have relevance to, or an effect on, the environmental impacts. The overall economics and cost/benefit aspects of the LMFBR program are such factors, and they were assessed by the AEC staff in the PFES. Therefore, EPA's review and comments encompass these aspects as well as specific environmental issues.

As was directed by the courts, the PFES addressed (as did the March 14, 1974, draft statement) the impacts of both the developmental program and the possible ultimate commercialization of LMFBR-type plants. We agree that this approach was and is appropriate, and we commend the AEC for its exhaustive efforts to explore the broader aspects of this evolving technology. After review of the PFES, we have concluded that (with the exception of those matters discussed in our enclosed detailed comments) the AEC has addressed the impacts and economic aspects of the overall LMFBR program about as well as can be expected, given the state of presently available information. In addition, this programmatic environmental statement is beneficial in that it tends to highlight areas of uncertainty and informational gaps—thereby aiding in focusing or redirecting research and developmental programs to provide needed answers. The PFES has generally served this purpose. However, the absence of definitive information in certain key areas restricts present impact analyses and, thus, severely limits the effectiveness of the PFES. It is this problem that is of most concern to EPA.

We believe the developmental portion of the LMFBR program can probably be conducted without any unacceptable adverse impacts on the environment. Nonetheless, there is some uncertainty surrounding the safety aspects of the Clinch River Breeder Reactor (CRBR) since there is a present lack of detailed design information. We realize that some of this information will be developed in the course of the necessary planning and design work and can be evaluated when the specific environmental statement and other documents are issued by the Nuclear Regulatory Commission in conjunction with the licensing of this facility. The PFES indicates that the general approach, as with light-water reactors, will be to utilize conservative design and siting practices to minimize safety risks. We agree that this will probably provide an adequate basic level of safety at the CRBR. Also, we are confident that, as new information is developed relative to safety, changes in plant design will be incorporated as necessary to ensure that the lowest practicable risk levels are maintained.

With respect to the commercialization aspects of the LMFBR program, our review of the PFES indicates that current information is inadequate to predict the ultimate environmental impacts with any certainty. Much of the information needed to make such predictions will come from ongoing and planned research and development. Similar uncertainty, in our opinion, clouds the evaluation of the economic and cost/benefit aspects of LMFBR commercialization. We have concluded from our review that overall LMFBR benefits are highly sensitive to variations in the assumed future electrical demand and uranium resource availability, neither of which is reliably known at this time. Thus, it is not currently possible to make accurate cost/benefit predictions regarding the program.

In spite of the existing environmental and economic uncertainties, EPA has not uncovered any evidence of unresolvable environmental problems which might preclude LMFBR commercialization. Thus, we see no reason for abandoning present and planned developmental efforts. However, in order to preserve flexibility for future energy decisions, we encourage ERDA to continue (and expand where necessary) substantive exploration of feasible alternatives so that these will be in a sufficiently advanced state of development, should LMFBR commercialization not be possible.

The PFES anticipates a developmental program that progresses rapidly to commercialization in order to capture the assumed benefits of breeder technology. However, in our opinion, the LMFBR would not be rendered significantly less economic relative to other energy alternatives should problems delay the onset of commercialization. Recent downward trends in energy demand projections, in particular, appear to reduce the possible adverse effect of delay on program benefits. For example, using the latest demand projections of Project Independence our preliminary analyses indicate that a delay of 4 to 12 years might be accommodated without significantly reducing the uranium conservation value of the breeder. This should not be construed as indicating that EPA is necessarily advocating a delay, but that sufficient evidence exists to warrant reexamination of LMFBR timing assumptions.

If it is established that additional time is indeed available for ERDA to consider LMFBR decisions, consideration should be given to the merits of program rescheduling. Present scheduling indicates what we believe to be highly optimistic assumptions concerning the time and effort needed for adequate resolutions of environmental and safety problems. If the developmental program were not tied to the earliest possible date for commercialization, additional time would be available to seek the best solutions to these problems and to optimize the overall program by utilizing new and possibly changing information relative to future uranium supply and energy demand. Further, although the PFES adequately considers possible nuclear and non-nuclear alternatives (based on current information), additional time could be used to advantage to refine such considerations and, thus, possibly improve environmental protection.

As was indicated previously, although the AEC has assessed projected impacts about as well as can be expected utilizing present information, the absence of information in certain key areas severely limits the PFES. We would encourage ERDA to reexamine the environmental aspects of the program to the extent possible and appropriate as new environmental and environmentally related information becomes available. If you or the ERDA staff have any questions concerning our comments, we would be happy to discuss them with you.

Sincerely yours,

SHELDON MEYERS,
Director, Office of Federal Activities.

Enclosure.

COMMENTS ON PROPOSED FINAL ENVIRONMENTAL STATEMENT: LIQUID METAL FAST BREEDER REACTOR PROGRAM

INTRODUCTION AND CONCLUSIONS

EPA has reviewed the Proposed Final Environmental Statement (PFES) prepared by the U.S. Atomic Energy Commission on the Liquid Metal Fast Breeder Reactor Program and issued January 16, 1975. In our review we have emphasized the AEC responses to our comments on the draft environmental statement (DES). Our major conclusions are summarized as follows.

In general, we believe the PFES has assessed the environmental impacts of the LMFBR program about as well as can be expected, given the state of present information. However, our review also indicates that some important unknowns and uncertainties still exist, in the areas of reactor safety, transpotration safety, radioactive waste disposal, and plutonium toxicity, which limit the accuracy with which environmental impacts can be forecast. Consequently, we were unable to conclude, on the basis of the information presented in the PFES, that commercial development of the LMFBR program can be accomplished without causing future unacceptable environmental impacts. Conversely, neither were we able to identify any unresolvable problems that would preclude LMFBR commercialization. In addition, for a limited number of demonstration facilities (such as may be required to develop the LMFBR technology), we believe an adequate level of safety can probably be provided utilizing conservative design and siting criteria.

In proceeding with the developmental efforts, there may be a buildup of inertia from governmental and industrial investment to follow through deployment of commercial LMFBRs. Since the environmental impacts of a single commercial LMFBR cannot presently be predicted with certainty (much less those of full deployment), we would question a decision, based on the PFES, to fully commit to LMFBR commercialization. In our judgment, such a decision should be made after an evaluation of information generated in the ongoing and planned research and development program, as it becomes available.

Our review of the cost/benefit analyses indicates that the LMFBR benefits presented are highly sensitive to variations associated with the assured future electricity demand and uranium resources, neither of which is reliably known at this time. Therefore, it is not currently possible to make accurate cost/benefit predictions regarding the program.

In our opinion, the time needed to resolve the environmental and safety questions associated with the LMFBR program may be greater than that provided in present scheduling. It appears, however, that additional time for such problems might be available. In view of the most recent energy demand projections by Project Independence, our preliminary analyses have led us to believe that a delay of four to twelve years in the commercialization of the LMFBR might be accommodated without significantly reducing the uranium conservation value of the LMFBR. This should not be construed as indicating that EPA is necessarily advocating a delay, but that sufficient evidence exists to warrant reexamination of LMFBR timing assumptions.

We encourage ERDA, in order to preserve flexibility for future energy decisions, to continue (and expand where necessary) substantive exploration of feasible alternatives so that these will be in a sufficiently advanced state of development, should LMFBR commercialization not be possible.

BENEFIT-COST ANALYSIS

Introduction

Our primary concern in reviewing the proposed final environmental statement (PFES) has been the adequate treatment of the potential environmental and safety impacts associated with the LMFBR program. We believe that the costs of avoiding or incurring these potential adverse environmental effects should be at least offset by the potential net economic benefits of the program. It is because of this critical balancing between potential environmental and economic effects that we have devoted our attention to the economic as well as the environmental aspects of the PFES. We want both to be presented as adequately as is possible in order to increase the likelihood that the proper balancing will be made.

The proposed final environmental statement (PFES) responds satisfactorily to all but two of the detailed EPA criticisms of the benefit-cost analyses presented in the draft environmental statement (DES). One area in which the PFES analysis is deficient is in the presentation of the results of the sensitivity analysis requested by EPA. In its comments, EPA requested a sensitivity analysis of the projected benefits of the LMFBR with respect to high and low values for four major conditions: (1) future supply of uranium; (2) capital cost difference between LMFBRs and LWRs; (3) level of future demand for electrical power; and (4) rate of introduction of HTGRs. Full exploration of the effects of these variations would have required the evaluation of 24 alternatives—eight basic "without LMFBR" alternatives and 16 "with LMFBR" alternatives reflecting the total number of combinations possible given two possible values for each of the four conditions that could be varied. Table 1 presents a summary of the 24 cases which would have been explored under the EPA request. In addition, Table 1 includes 12 additional cases that were evaluated and presented by the AEC as part of the sensitivity analysis. These latter cases reflect a pessimistic assumption about the supply of uranium.

The purpose of the sensitivity analysis was to investigate the degree to which the projected benefits of the LMFBR program vary with different assumptions about uncertain future conditions. In particular EPA believed that energy demand in the year 2020 possibly could be some 50 percent smaller than that projected using the base projection; that the uranium supply could be significantly greater than that projected for the base case; that the capital cost differential between LMFBRs and LWRs could be significantly higher than the base projection; and that the HTGR growth constraints might be overcome by a change in program emphasis.

Most observers would agree that with respect to the base energy demand, capital costs, and HTGR constraints, deviations from the base projections are likely to be in only one direction—definitely downward—given recent population growth and energy demand experience. Such agreement could not be found with respect to the projected uranium supply. AEC correctly supplemented the requested sensitivity analysis with consideration of a pessimistic projection of future uranium supplies. Their pessimistic forecast reflects the belief of many that future uranium supplies will be limited to today's known and potential reserves.

The second area in which the PFES responds poorly to EPA's comments is in the analysis of the effects of a delay in the introduction date of the LMFBR on the anticipated benefits of the program. The analysis presented in the PFES restricts attention to cases that are for the most part unfavorable to any delay, i.e., cases where at most one adverse future condition occurs. In subsequent sections, we have carried out some primitive analyses to establish a context for viewing the possible effects of a delay in the LMFBR introduction date. The PFES would be greatly improved were it to expand its treatment of the question of timing of LMFBR introduction including additional sensitivity analyses using the benefit-cost model.

PROBLEMS WITH THE ANALYSIS OF THE SENSITIVITY CASES

Apparent incorrect base for measuring benefits

The measure of gross benefits attributable to the LMFBR is basically the cost savings realized by providing energy to meet the projected level of demand with LMFBR's over the costs of meeting the demand by LWR's. In calculating benefits, therefore, the only difference between the reference base case and the LMFBR case should be the presence of the LMFBR. In Table 1, each reference base case has two LMFBR cases for comparison because two levels of LMFBR capital costs have been postulated. Except for the cases including a constraint on HTGR reactor introduction, the conditions for the base cases correctly do not vary from the comparative LMFBR cases with respect to any of the variable conditions.

This correspondence fails in the HTGR constrained cases because the reference base cases assume a constraint on HTGR introduction up to the year 2020 while the comparative LMFBR cases assume constraints only to the year 2000. In Table 1, base cases 13, 16, 22, 31, and 34 suffer from this apparent error. The results for base case 19 comparisons were not presented in Appendix Table IV D–1; it is not known if the same mistake was made there.

The effects of this non-conformity on gross benefits calculation could be highly significant. No base runs including a year 2000 constraint on HTGR introductions were presented in Table IV D–1, however, an indication of the effect of the apparent error is provided by the PFES, Table 11.2–23. According to the data in the first row of the table, the gross benefits of the LMFBR program are $19.4 billion when the HTGR capacity constraints to the year 2020 are imposed for the non-breeder comparison. If the HTGR capacity constraints are applied only to the year 2000 for the non-breeder case and all other assumptions are held constant the gross benefits drop to $14.6 billion.

Footnote "a" in Table 11.2–23 states that the constraints were not "imposed (or needed)" beyond the year 2000 for the cases with the breeder present. This statement implies that the reduction in gross benefits from $19.4 to $14.6 billion can be attributed wholly to the reduction in the present value of the total costs of producing energy in the non-breeder base cases brought about by relaxing the capacity constraints on the HTGR during the period from the year 2000 through 2020.

These data suggest that if the base case 1 in Table IV.D–1 had HTGR capacity constraints imposed only to the year 2000, the energy cost would be $206 billion instead of $210.8 billion. And, more importantly, the gross benefit of case 3 in Table IV D–1 would be reduced from $19.4 to $14.6 billion.

The data in Table 11.2–23 are not sufficient to allow a similar evaluation of the benefits estimated for the other cases in Table IV D–1. However, the same inconsistency with respect to the HTGR constraints between the base cases and the comparison LMFBR cases persists for all the estimates. The HTGR capacity constraints are applied up to the year 2020 for the non-LMFBR base cases. The constraints apply only through the year 2000 for the LMFBR comparison cases. If the comparison between cases 1 and 3 in Table IV D–1 is representative, the elimination of the HTGR constraints for the period from the year 2000 to the year 2020 could reduce the estimated value of gross benefits of the LMFBR by about 25 percent.

Certainly, the evidence is sufficiently great to request that the HTGR constrained base cases be rerun with a year 2000 constraint instead of a year 2020 constraint. Depending on the unknown differential effects of the HTGR and the LMFBR, the benefits reported for the HTGR constrained cases could be significantly reduced.

Until this confusion with respect to true benefits is cleared up, the results of the benefit-cost analysis must be questioned. The most direct way to resolve the problem would be to run the HTGR constrained cases for a year 2000 constraint and the comparative cases with a year 2020 constraint. In that way complete estimates of the effects of both the 2020 and 2000 constraints could be evaluated.

Failure to analyze several of the sensitivity cases

EPA requested a sensitivity analysis of the combined effects of two possible values for four of the major inputs to the benefit-cost analysis. The sensitivity analysis required the evaluation of 16 possible cases (2, 3, 5, 6, 8, 9, 11, 12, 14, 15, 17, 18, 20, 21, 23, and 24) in Table 1. Table IV D–1 in the Appendix omits results for six of the requested cases (cases 3, 8, 9, 15, 20, and 21) in Table 1. The results for cases 3, 8, and 9 do appear, however, in graphical form in Figure 11.2–11 of the benefit-cost document. The results for cases 15, 20, and 21 were not found anywhere in the report. The circled results presented in the gross benefit column of Table 1 were estimated by interpolation. For the sake of completeness, the document should include analyses of all of the requested 16 cases and the results should all appear in Table IV D–1.

PROBLEMS WITH THE PRESENTATION OF RESULTS OF THE SENSITIVITY ANALYSIS

Summary results of the sensitivity analysis

Table 1 in this document contains 36 cases: 12 base cases and 24 LMFBR cases. The 24 LMFBR cases constitute the sensitivity analyses for 2 values of LMFBR capital costs, 2 assumptions about HTGR's, 2 levels of energy demand, and 3 levels of uranium supply ($2\times2\times2\times3=24$). The 24 cases can be broken down into two 12-case sets according to the presence or absence of a constraint on the introduction of HTGR's. Figures 11.2–10 and 11.2–11 in the PFES purportedly present the results of the sensitivity analysis following this breakdown. Figure 11.2–11 presents the results for the 12 cases with no HTGR constraint. The companion Figure 11.2–10, however, omits three important cases—cases 15, 20, and 21 in Table 1 of this document. Inclusion of the results for these three cases would alter the visual impression of Figure 11.2–10. The benefit picture would definitely be less favorable to the LMFBR. Figure 11.2–10 should be modified to include these results for cases 15, 20, and 21 in Table 1.

Interpretation of the effects of changing conditions on the benefits of the LMFBR

Tables 11.2–23, 11.2–24, and 11.2–25 in the PFES present data to show the independent effects of variation in HTGR constraints, uranium supply, and LMFBR capital costs on the estimated benefits of the LMFBR program. Such a table is not presented for the effects of variation in energy demand. The effect of energy demand is poorly presented in the discussion on pages 11.2–138 through 11.2–142 and in Figure 11.2–38. The tables tend to be confusing in that the data are gross benefit values, and yet the tables' titles refer only to "benefits." Before these benefits can be viewed as net benefits, the $4.9 billion (present worth) cost of the LMFBR program must be subtracted. This feature of the tables should be made clear in ERDA's final environmental statement (FES).

The tables (11.2–23 through 11.2–25) are useful in that they indicate marginal changes. They indicate the size and direction of the effects of variations on the estimated gross benefits of the LMFBR program. Because of their composition, however, they do not provide sufficient information on the range of effects of the various assumptions on the viability of the LMFBR program, i.e., the extent to which variations in the conditions change the estimated value of the benefit-cost ratio of the program. Tables 11.2–23 and 11.2–25, in particular, appear to contain sets of selected cases that display relatively very high levels of gross benefits. An improved way to display the independent effects of variation in each assumed condition would be to present the whole array of the 24 sensitivity cases organized in such a fashion as to elucidate the independent effects better. For example, Table 2 presents the data in a way that emphasizes the partial effects of changes in the uranium supply given any of the 8 distinct sets of future conditions that are associated with each of the three possible levels of uranium supply.

Table 2 shows the marked effect that the supply of uranium has on LMFBR net benefits—all other conditions being equal. In each of the 8 possible combinations of values for the other three conditions HTGR constraint, LMFBR capital cost, and level of energy demand), changes in the direction of increased uranium supply tend to cut the perceived net benefits of the LMFBR in half for each incremental change. In view of this volatility of net benefits with respect to uranium supply, it would appear desirable to collect more information on uranium supply before making a total commitment to pursue the net benefits of the LMFBR program.

The last column of Table 2 clarifies an issue which is raised on page 11.3–1 in the PFES conclusions, "The ratio (B/C) falls below one only when two or more large adverse circumstances—each considered unlikely—are assumed to occur in concert." So long as the unconstrained introduction of the HTGR is considered a "large adverse consequence," this statement is true. If the unconstrained HTGR condition is not viewed as unlikely, then the number of adverse conditions for 12 of the cases in Table 2 are reduced by 1 to equal the numbers in parentheses in the last column. Then in two instances the net benefits of the LMFBR program are negative with the occurrence of only one adverse condition—either high LMFBR capital costs or very low demand (cases 3 and 8 in Table 2).

Table 2 points up the significance of the uranium supply assumption with respect to the net benefit estimate. Similar tables could and should be included in ERDA's environmental statement to present more clearly the range of marginal effects of changes in the assumptions about energy demand and LMFBR capital costs.

ADOPTION OF A DECISION RULE FOR DECISION UNCERTAINTY

There are several combinations of possible future conditions that could result in the benefit-cost analysis yielding negative net benefits (11 of the 24 cases presented in Table 1). The benefit-cost analysis could deal better with implications of these negative benefit cases in terms of the overall assessment of whether the dollar benefits of the LMFBR program exceed the dollar costs.

For example, one way to deal with uncertainty is to assign equal likelihood to a range of many possible futures and then calculate the expected value of gross benefits of the LMFBR program for each possible future. Table 3 presents the results of two such expected value analyses. Expected gross benefits are calculated under two assumptions, first it is assumed that all of the 24 LMFBR cases in Table 1 are equally likely to occur. Under that assumption, the expected gross benefits of the LMFBR program are $8.4 billion : in the second case, the very low uranium supply cases have been eliminated. The remaining 16 cases are then considered equally likely to occur. Even under that assumption (adverse to the LMFBR), the expected gross benefits of $5.6 billion exceed the development costs of $4.9 billion.

The expected value, however, is perhaps less appropriate a measure of benefits than some other not so mechanical criterian, such as minimizing the maximum regret. In Table 1, the most adverse conditions with respect to the LMFBR occur in case 12, where HGTR introduction is unconstrained, LMFBR capital costs are very high, energy demand is very low, and the uranium supply is optimal. In that case, the projected net benefit of the LMFBR is minus $4 billion; i.e., the nation would end up losing some $4 billion if the LMFBR program were adopted. On the other hand, case 31 in Table 1 contains the conditions most favorable to the LMFBR. In that case the projected net benefits of the program are $26 billion, i.e., the net cost of not developing the LMFBR could be $26 billion. Thus, the maximum regret for developing the LMFBR could be $4 billion; the maximum regret for not developing could be $31 billion. Clearly, maximum regret would be minimized by going ahead with the LMFBR program.

Ultimately, the acceptance or rejection of LMFBR program must be based upon a scheme for dealing with uncertainty that surpasses the discussion in the existing benefit-cost analysis. The method of dealing with uncertainty should be made explicit in the final benefit-cost analysis.

PROBLEMS WITH THE BASE CASE ENERGY DEMAND PROJECTION

Consideration of Project Independence total energy demand projection

1. Likelihood the Base Projections are High.

As part of the Project Independence Report, FEA prepared base case projections for total energy demand as a function of the price of oil over the short-term period from 1972 to 1985. With the price of imported oil at $7 per barrel total energy demand was projected to grow at 3.2 percent per year. With a price of $11 per barrel total energy demand was projected to grow at 2.7 percent per year.

Project Independence also projected a long term "Base Case" total demand for energy. According to that projection, total energy consumption should grow at a rate of about 2.5 percent per year from 1985 through the year 2020.

Total energy demand for the year 1970 was 67 Btu $\times 10^{15}$ according to Table 11.2–7 of the PFES. Similarly, the PFES base 1 case forecast of total energy demand is 859 Btu $\times 10^{15}$. The base case Project Independence projections can be compared to the PFES base case projection by applying the Project Independence growth rates to the 1970 demand as follows:

$$E=67 \exp(15r) \exp(35\times .025) \quad (1)$$

where r is the appropriate rate of growth of total energy demand.

The PFES projection for electric energy demand assumed that 65 percent of the total energy demand in the year 2020 would be met by electric power generation. Applying the same assumption to the Project Independence derived numbers, one gets the following set of projections.

Base cases	Total energy demand, year 2020	Electrical energy demand 2020
$7 per barrel oil	260 Btu$\times 10^{15}$	20.3 kWh$\times 10^{15}$.
$11 per barrel oil	240 Btu$\times 10^{15}$	18.8 kWh$\times 10^{15}$.
PFES	359 Btu$\times 10^{15}$	28.0 kWh$\times 10^{15}$.

These figures indicate that if the base case Project Independence projections are correct, electric energy demand for the year 2020 will be 33 percent or 28 percent less than that projected by the PFES base case, depending upon whether the price of an imported barrel of oil is $11 or $7, respectively.

Apparent inconsistence of population and total energy demand projections

The PFES provides its base national energy forecast in Table 11.2–7 on page 11.2–53. According to the text, the "projections of total energy consumption and energy inputs to the electrical sector were made on the basis of their historical relationship to the real Gross National Product (GNP)." The apparent basis for the GNP estimates was the E series population projection of the Bureau of the Census.

Examination of the historical population, GNP, and total energy demand data, however, suggests that the PFES total energy demand and GNP projections may not be consistent with the population projection at least in terms of past experience.

	1950	1972	Actual growth rate 1950–72	PFES forecas growth rate 1970–2020
U.S. population	151,320,000	208,840,000	1.45	0.81
Total energy demand			[1] 3.4	3.4
GNP (1958 dollars)	$355,000,000,000	$789,000,000,000	3.6	3.6

[1] Rate cited on p. 11.2–54 of PFES.

During the period from 1950 to 1972 the U.S. Population grew at an annual average rate of 1.45 percent per year. During that time, total energy demand and GNP grew at rates of 3.4 and 3.6 percent, respectively. If there is some relationship between population growth and growth in these other two measures, it seems anomalous to retain such historical high rates of growth in energy demand and GNP while projecting such a reduced rate of growth in population, as has been done for the PFES base case forecast.

The projected rate of growth of population over the period from 1970–2020 is only 56 percent of the population growth rate over the period from 1950 to 1972. It would be extreme to argue that a comparable reduction in the rate of growth of total energy demand would also occur. An annual growth rate in total energy demand of 2.5 percent (as projected by Project Independence for the period 1985–2020) would be equal to 74 percent of the earlier period's 3.4 percent growth rate. Such a reduced rate would appear more consistent with the projected reduced rate of population growth.

Implication of Project Independence projections for the optimal timing of the LMFBR introduction date

On page 80 of EPA's comments on the DES, it was suggested that the question of optimal timing for the introduction of the LMFBR ought to be discussed in the PFES. Unfortunately, the PFES analyzes the effects of timing for too few alternatives to make a reasonable evaluation. Table IV D–1 contains information on timing for cases in which at most one adverse assumption is made with respect to the overall base case. Very importantly, the effect of timing given the (—50 percent) demand projection is not presented under any conditions.

The essential justification for the LMFBR is that it will allow nuclear power to expand with lower costs for fuel. The breeders will decelerate the rate of consumption of lower and lower grade uranium resources at higher and higher prices. On the other hand, development of LMFBR is going to be a costly program. The optimal time for introduction of the LMFBR would, therefore, appear to depend upon a trade off between discounted costs of development and the discounted opportunity cost of having to pay higher prices for nuclear fuel than would be necessary were the breeder available. The speed at which higher prices for uranium will develop is a function of the availability of uranium resources and the rate at which demand for energy grows. It seems logical that either some level of depressed demand or some level of expanded uranium supply or some combination of lowered demand and increased uranium supply would cause the optimal timing for LMFBR introduction to be postponed beyond the 1987 date proposed by the PFES.

The Project Independence projections for total energy demand in the year 2020 are 28 percent and 33 percent lower than the PFES energy demand projection for the base case. It would be valuable to know if either of these projected demands would alter the optimal timing for LMFBR introduction. Cases 15 and 16 in Table IV D–1 of the PFES indicate that a (—20 percent) demand would not delay the optimal timing of LMFBR introduction. However, according to Table IV D–1, the discounted total cost of meeting energy demand under the base projection without the LMFBR is $210.8 billion while the discounted total cost for a (—20 percent) demand would be $188.4 billion. A 20 percent lower demand in the year 2020 results in a 10.6 percent reduction in the discounted total costs; but the cost savings of the LMFBR are still great enough to preclude delay of its introduction without opportunity losses in the (—20 percent) demand case.

The relative values of the figures in Table IV D–1, however, make one wonder whether the analytical benefit-cost model is constructed in such a way as to accurately assess the effects of timing of the LMFBR introduction date. Under the base demand projections, delay of the introduction date from 1987 to 1991 results in a reduction of gross benefits of $3.0 billion (difference between case 3 and 4 gross benefits). In the (—20 percent) demand case, the reduction in gross benefits from the same delay is $2.9 billion (cases 15 and 16). In the (+20 percent) demand case. the reduction is $3.8 billion. The cost of delay in the (—20 percent) demand case is only 3.3 percent less than the cost of delay in the base case. whereas the cost of delay in the (+20 percent) case is 26.7 percent greater than the cost of delay in the base case. Admittedly, the increasing cost of uranium might make the increased cost of delay in the (+20 percent) case proportionally greater than the decreased cost of delay in the (—20 percent) case but the difference between 3.3 percent and 26.7 percent appears unexpectedly large.

This anomaly plus the absence of analysis of the effects of timing on gross benefits with the (—50 percent) demand indicate that the basic model may not deal effectively with variation in timing assumptions. The final impact statement should provide an improved treatment of the timing question with respect to introduction of the LMFBR under the full range of conditions represented by the 16 sensitivity analysis cases, for delays in timing of 5, 10, and 15 years.

If the basic model is deficient in dealing adequately with timing, the problem should surface in carrying out the analyses and appropriate adjustments can, if needed, be made in the model.

A simplistic approach toward assessing the effect of reduced demand on the optimal timing of LMFBR introduction

If one ignores the complex linear programming benefit-cost model, it is possible to construct a simple model that provides at least an intuitive notion of the potential effects of reduced demand on optimal timing of LMFBR introduction. The main benefits of the LMFBR derive from its uranium conservation. For example, a full $16.6 of the estimated $19.4 billion of discounted gross benefits of the breeder consist of cost savings on uranium (PFES, Page 11.2–6). The savings represent the avoidance of having to use lower grade and higher cost uranium resources.

According to Figure 11.2–7 on page 11.2–30, it appears that the LMFBR does not begin to have a significant impact on system power costs until the year 2000 even with introduction around the year 1987. Further, it appears that 1987 is the earliest possible time at which the LMFBR could be introduced. Assuming the PFES base case growth in electrical energy demand is realized, the most benefits that can accrue to the LMFBR occur with the 1987 introduction. With such a scenario, most of the nuclear power generated over the period from 1970 to the year 2000 will use enriched natural uranium fuels.

One way to assess, in a simplistic manner, the implications of reduced energy demand on optimal timing of the LMFBR introduction date is to concentrate on the uranium supply picture. The base demand and 1987 introduction date imply the consumption of some fixed quantity of natural uranium—most of which will be consumed during the period from 1970–2000. The 1987 date appears feasible in terms of the cost of uranium supply given base demand. Similarly, then, some introduction date later than 1987 would be feasible in terms of the costs of uranium supply given a reduced growth in energy demand. In particular, the delayed introduction date that requires a cumulative cost of natural uranium at the year 13 years beyond that introduction date which is equal in present value to the cost of natural uranium up to the year 2000 given a 1987 introduction date and base demand, should be feasible.

According to Table 11.2–7, the gross energy inputs to electric utilities will grow from 17 Btu$\times10^{15}$ to 97 Btu$\times10^{15}$ over the period from 1970 to the year 2000. This represents an annual average growth rate of 5.7 percent per year. If one takes the Project Independence growth rates for total energy demand for $7 and $11 per imported barrel of oil, calculates the projected total energy demand for the year 2000 and converts these total energy demands to gross energy inputs to electric utilities using the same ratio as that for the base case shown in Table 11.2–7, one obtains comparable growth rates over the same period (1970–2000) of 5.2 and 4.7 percent per year.

Using these growth rates it is possible to calculate the gross energy inputs to electric utilities in terms of Btu$\times10^{15}$ for each year over the period from 1970 to 2000 for each of the assumed growth conditions using the following formula,

$$EEt = 17 \exp (r_t)$$

where r is either 0.057, 0.052, or 0.047, depending on whether the PFES base, or the Project Independence $7, or $11 barrel growth conditions are assumed, respectively.

If one assumes that the amount of expenditures for uranium increases proportionally to the increase in electrical utility energy demand, then cumulative demand for energy can be used as a gross surrogate measure for the cumulative expenditure for uranium. Given these assumptions, it is possible to find the years at which the present value of the cumulative demand for electrical energy under the Project Independence growth rates is equal to the present value of the cumulative demand for that energy in the base case over the period from 1970 to 2000. The year 2000 is associated with the 1987 LMFBR introduction date. Therefore, the number of years beyond 2000 that it takes to reach an equivalent discounted cumulative consumption can, given the assumptions, be assumed to be the number of years that introduction could be delayed without suffering an increased penalty owing to uranium shortage.

Using a discount rate of 10 percent, the present value of cumulative gross energy inputs to electric utilities over the period from 1970–2000 under the PFES base case is:

$$C_B=\int_0^{30} 17 \text{ exp. } (0.57t)\times\text{exp. } (-0.10t)dt$$

$$C_B=287.5$$

Given a 5.2 percent per year estimated growth rate for the $7 per barrel Project Independence projection, an equivalent present value of cumulative electric utility energy consumption would be reached by *Y*, where *Y* can be calculated as follows:

$$\int_0^{Y} = 17 \text{ exp. } (0.052t) \text{ exp. } (-1.10t)dt=286.5$$

$$Y=34 \text{ years}$$

Similarly, the year at which the same cumulative demand would be realized with the $11 per barrel projection is equal to:

$$\int_0^{Z} 17 \text{ exp. } (0.047t) \text{ exp. } (-0.10)dt=296.5$$

$$Z=42$$

Thus we see that with the rates of growth projected by Project Independence, introduction of the breeder might be delayed as much as 4 to 12 years without increasing the present value of expenditures for uranium above those projected for the base case by PFES.

Given the extremely simplistic and unrefined nature of this exercise, the conclusions must naturally be suspect. Nevertheless, they do reinforce intuition and do indicate that early introduction of the LMFBR may not be so critical as supposed.

Estimated costs of 9 to 11 years delay owing to lower demand

According to the data in Table IV D–1, the present value of the gross benefits of the LMFBR program under base demand and a 1987 introduction date is $19.4 billion. Delay of the introduction date to the year 1991 reduces this value to $16.4 billion. Four years delay results in a benefit reduction of $3 billion or 15.5 percent. This averages out to a 3.8 percent reduction in gross benefits per year of delay.

Similarly, Table IV–D–1 indicates that if the year 2020 demand is 20 percent less than the base case, then the present value of gross benefits of the program is reduced to $11.2 billion. This 26.8 percent reduction in benefits averages out to be a 1.3 percent reduction for every 1 percent drop in the level of projected demand for the year 2020.

If one calculates the year 2020 demands for the $7 and $11 per barrel Project Independence estimates, they end up being 27.6 and 33.1 percent lower than the PFES base case projection. With an estimated drop in gross benefits of 1.3 percent for each percentage drop in demand, the present value of gross benefits for the $7 projection should be 35.9 per cent lower than for the base case and for the $11 case they should be 43.0 percent lower.

The $7 per barrel projection has the same effect on gross benefits as a 9 year delay in the introduction date; and the $11 projection has the same effect as an 11.5 year delay. One can conclude, therefore, that the risk of a 9–12 year delay in order to insure environmental concerns would be no greater in terms of potential costs than the risk that presently exists that projected benefits will be significantly smaller than for the base case owing to lowered future demand as predicted by Project Independence.

Effect of R. & D. costs on the LMFBR timing issue

A graduate student at Harvard University has prepared a draft paper describing his ongoing investigation of the LMFBR timing issue.[1] Using a model very similar to that used for analysis in the PFES, Richels attempts to isolate the effects of the timing of LMFBR commercialization on the projected benefits of the program. Unlike the PFES assumption, however, he assumes that research and development costs do not increase as a result of stretch out or delay in the program. Richels finds that if undiscounted R & D costs are independent of LMFBR introduction date, i.e., that the present value of R & D costs declines as the introduction date is pushed back, then optimal timing for introduction of the LMFBR could be as late as the year 2000 depending upon future conditions. For example, with a 10 percent discount rate, a high uranium cost curve, a high demand projection, and a $100/kw capital cost differential between LWR's and the LMFBR, the optimal introduction date for the LMFBR is the year 2000.[2]

Richels recognizes that his assumption about the R & D costs is critical to his results. If the AEC's assumption that the discounted R & D cost curve slopes upward as the introduction date is deferred beyond 1987, then he admits that the contention that the LMFBR should be introduced as soon as possible would be correct for most of the future conditions postulated in the PFES.

The AEC assumption about increased R & D costs derives from the notion that the longer a project takes, the longer the program has to keep teams and facilities geared up, and the more it is going to cost. Richels counters that assumption by other experience which shows that it is frequently possible to hold down overhead and other fixed costs by designing the R & D program to run more in terms of sequential than concurrent phasing. He even suggests that,

TABLE 1.—SENSITIVITY CASES

Case No.	EIS case No. (base case)	LMFBR	HTGR constraint	Number of base case for comparison	LMFBR cap. cost	Energy demand	Uranium supply	Energy cost	Gross benefit
1	30	No	None			Base	Base	202.3	
2	47B	Yes	None	1	Base	do	do	190.1	12.2
3	(1)	Yes	None	1	+100	do	do		[2](4)
4	45	No	None			do	Optimum	197.0	
5	46	Yes	None	4	Base	do	do	189.3	7.8
6	54	Yes	None	4	+100	do	do	195.2	1.9
7	(1)	No	None			—50 percent	Base		
8	(1)	Yes	None	7	Base	do	do		[2](4)
9	(1)	Yes	None	7	+100	do	do		(1)
10	49	No	None			do	Optimum	146.8	
11	50	Yes	None	10	Base	do	do	143.8	3.0
12	57	Yes	None	10	+100	do	do	145.9	.9
13	1	No	2020			Base	Base	210.8	
14	3	Yes	2000	13	Base	do	do	191.4	19.4
15	(1)	Yes	2000	13	+100	do	do		[2](6)
16	5	No	2020			do	Optimum	201.4	
17	7	Yes	2020	16	Base	do	do	189.4	12.0
18	55	Yes	2000	16	+100	do	do	196.6	4.8
19	(1)	No	2020			50 percent	Base		
20	(1)	Yes	2000	19	Base	do	do		[2](6)
21	(1)	Yes	2000	19	−100	do	do		[2](2)
22	48	No	2020			do	Optimum	148.1	
23	52	Yes	2000	22	Base	do	do	144.2	3.9
24	58	Yes	2000	22	+100	do	do	147.7	.4
25	59	No	None			Base	Pessimistic	211.6	
26	61	Yes	None	25	Base	do	do	192.1	19.5
27	68	Yes	None	25	+100	do	do	200.6	11.0
28	63	No	None			—50 percent	do	152.8	
29	65	Yes	None	28	Base	do	do	145.9	6.9
30	71	Yes	None	28	+100	do	do	149.4	3.4
31	9	No	2020			Base	do	225.3	
32	11	Yes	2000	31	Base	do	do	194.7	30.6
33	69	Yes	2000	31	+100	do	do	201.5	23.8
34	62	No	2020			—50 percent	do	157.3	
35	66	Yes	2000	34	Base	do	do	146.9	10.4
36	72	Yes	2000	34	+100	do	do	150.6	6.7

[1] Results for these cases do not appear in table IV. D-1.
[2] Values for cases 3, 8, and 9 appear in fig. 11.2-11 on p. 11.2-19. Values for cases 15, 20, and 21 have been estimated by interpolation.

[1] Richels, Richard, "The LMFBR Timing Issue," draft paper, John F. Kennedy School of Government, Harvard University, Mar. 3, 1975.
[2] Ibid., p. 12.

with effective planning, an extension in project completion time can lead to a reduction in undiscounted R & D costs and that if this were the case for the LMFBR, the optimal commercialization date might come even later than the year 2000 in his example case.

The fact of the matter is that a delay in the introduction date of the LMFBR is by no means certain to result in a reduction of the net benefits of the program. Depending upon future demand conditions and the effect of "stretchout" or delay in the R & D program costs, the postponement of introduction could have positive as well as negative impacts on the overall benefit of the program.

TABLE 2.—EFFECT OF VARIATION IN URANIUM SUPPLY ON LMFBR NET BENEFITS

Case No.	EIS case No.	LMFBR	HTGR con-straint	LMFBR cap. cost	Energy demand	Uranium supply	Net benefit (billions)	Number of assumption in effect [3]: Adverse	Number of assumption in effect [3]: De-crease
26	61	Yes	None	Base	Base	Pessimistic	$15	1	
2	47B	Yes	None	Base	do	Base	7	1	(0)
5	46	Yes	None	Base	do	Optimum	3	2	(1)
27	68	Yes	None	+100	do	Pessimistic	6	2	(1)
3	(1)	Yes	None	+100	do	Base	[2] (−1)	2	(1)
6	54	Yes	None	+100	do	Optimum	−3	3	(2)
29	65	Yes	None	Base	−50 percent	Pessimistic	2	2	(1)
8	(1)	Yes	None	Base	do	Base	[2] (−1)	2	(1)
11	50	Yes	None	Base	do	Optimum	−2	3	(2)
30	71	Yes	None	+100	do	Pessimistic	−2	3	(2)
9	(1)	Yes	None	+100	do	Base	[2] (−4)	3	(2)
12	57	Yes	None	+100	do	Optimum	−4	4	(3)
32	11	Yes	2000	Base	Base	Pessimistic	25	0	
14	3	Yes	2000	Base	do	Base	14	0	
17	7	Yes	2000	Base	do	Optimum	7	1	
33	69	Yes	2000	+100	do	Pessimistic	19	1	
15	(1)	Yes	2000	+100	do	Base	[2] (−1)	1	
18	55	Yes	2000	+100	do	Optimum	0	2	
35	66	Yes	2000	Base	−50 percent	Pessimistic	5	1	
20	(1)	Yes	2000	Base	do	Base	[2] (−1)	1	
23	52	Yes	2000	Base	do	Optimum	−1	2	
36	72	Yes	2000	+100	do	Pessimistic	2	2	
21	(1)	Yes	2000	+100	do	Base	[2] (−5)	2	
24	58	Yes	2000	+100	do	Optimum	[2] (−4)	3	

[1] See footnote 1, table 1.
[2] See footnote 2, table 1.
[3] Adverse assumptions are those assumptions which reduce the estimated benefits of the LMFBR.

TABLE 3.—ILLUSTRATIVE EXPECTED VALUE ANALYSES

Case No.	Gross benefit	Equal likelihood probability	Expected gross benefit	Equal likelihood prob. excluding pess. U_3O_8	Expected gross benefit
2	12.2	0.0416	0.510	0.0625	0.762
3	4.0	.0416	.167	.0625	.250
5	7.8	.0416	.325	.0625	.488
6	1.9	.0416	.079	.0625	.119
8	4.0	.0416	.167	.0625	.250
9	1.0	.0416	.042	.0625	.062
11	3.0	.0416	.125	.0625	.188
12	.9	.0416	.037	.0625	.056
14	19.4	.0416	.810	.0625	1.210
15	6.0	.0416	.250	.0625	.375
17	12.0	.0416	.500	.0625	.750
18	4.8	.0416	.200	.0625	.300
20	6.0	.0416	.250	.0625	.375
21	2.0	.0416	.083	.0625	.125
23	3.9	.0416	.163	.0625	.244
24	.4	.0416	.017	.0625	.025
26	19.5	.0416	.810		
27	11.0	.0416	.460		
29	6.9	.0416	.288		
30	3.4	.0416	.142		
32	30.6	.0416	1.270		
33	23.8	.0416	.990		
35	10.4	.0416	.416		
36	6.7	.0416	.280		
Total			8.381		5.579

SAFETY

Introduction

In its review of the draft environmental statement for the LMFBR program (DES), EPA commented on several safety related issues. The principal thrust of these comments was that the discussion of LMFBR safety (1) suffered from a lack of quantitative information and (2) did not fully address the unresolved safety questions associated with critical design aspects of the reactor, which relate directly to potential environmental consequences. As a result, we were unable to conclude that the environmental impact of the LMFBR program would be minimal, nor could we determine the approaches that would be taken to ensure satisfactory resolution of important safety questions. We recognize that the programmatic nature of the environmental statement results in possible difficulty or even inability to provide technical details to estimate environmental risks at this time when substantial research and development efforts remain to be accomplished.

Based on our review of the PFES, it is apparent that the AEC expended considerable effort in attempting to address the safety related issues previously raised. We commend their efforts, recognizing that development of much of the detailed information was impossible at this stage of the program. Even though the additional quantitative information significantly improves the description of the design criteria, the AEC design philosophy, and the general intended approaches to ensuring safety, there is still a lack of definitive information that would provide the reader with the status of the principal unresolved safety problems, their current degree of resolution, and the on-going or required research and development needed to achieve the safety objectives.

Our comments on the DES in this regard may have been misinterpreted; however, they were intended to reflect NEPA requirements which were emphasized in the court decision on the LMFBR program DES, i.e., the DES should ". . indicate the extent to which environmental effects are essentially unknown." The AEC, in the PFES, has detailed the general requirements for the design and has provided commitments for future designs but there appeared to be limited discussion of the degree of resolution of the safety aspects as a basis for predicting potential environmental effects. Specific examples of this deficiency will be presented subsequently. While we concur with the general commitments and the general approach to ensuring safety as indicated in the PFES, the specific safety problems, their expected solutions and the projected environmental impacts must eventually be publicly detailed and reviewed. We accept the AEC position that at this time the programmatic nature of the PFES made such detailed environmental risk analyses impossible now. However, we believe that some of this information with regard to the status of problem solution can be provided in the FES.

Following our comments on the draft statement, EPA staff were invited to numerous LMFBR safety-related briefings and program review meetings. This participation has been appreciated and has resulted in providing our staff with an improved awareness of the status of the LMFBR program activities. Based on this participation, it is believed that some of the LMFBR safety issues may be much further toward resolution than is reflected in the PFES. In fact it appears that many of the deficiencies of the PFES are a result of incomplete documentation rather than lack of a solution. Specifically, the PFES frequently cites fast reactor followon studies as sources of related information. Yet on page 4.2–12 the PFES states, "It must be recognized that those studies were limited in scope and that much of the detailed information to conduct a precise environmental analysis of a commercial LMFBR power plant was not developed." We believe that in view of the experimental and analytical work which has been performed since the completion of the follow-on studies, their content may now largely be outdated.

In summary we conclude that: (1) the PFES does not include design details and, therefore, no quantitative evaluation of the environmental impact of the LMFBR can be made at this time and (2) there are unresolved technical safety problems which are being investigated and for which solutions are believed to exist, at least in part, but are not known with confidence. These conclusions are the focal points of most of our comments on the DES and to the AEC responses in the PFES as indicated in the specific comments which follow.

Specific comments

1. The PFES (page 4.2–235) provides a review of a panel discussion of LMFBR safety experts where the reported consensus of the probability of a major LMFBR accident was placed at 10–7 per year which was concluded to be an acceptable environmental risk. In fact a great deal more design and performance data and analyses are required before the risks of the LMFBR can be evaluated. Risk acceptability is indeed a complex subject which demands technical, social and legal inputs. To our knowledge such conclusions have not yet been reached for the LWR, much less the LMFBR. We commend the AEC's efforts to evaluate (quantify) the risks of the LMFBR. If possible, the FES should provide more amplification on this program effort including the presently limiting factors (information, technical detail, developmental work, etc.) and the anticipated time frame for the completion of the analyses. We believe that this type of effort is paramount to acceptance of a commercial LMFBR.

2. Uncertainties in various important safety related design parameters should be quantified where possible in such a manner to be more comprehensible. (The risk assessment may do this.) For example, there could be substantial uncertainties in the possible structural integrity of the primary coolant system related to a hypothetical core disruptive accident (HCDA). As indicated on page 4.2–163 concerning the FFTF, "At the upper end of the spectrum one could qualitatively argue that the event was so large that the basic structural integrity of the primary system was lost. In this case, massive sodium and fuel expulsion could take place with consequences correspondingly more severe." Unless uncertainties such as these are eliminated or greatly reduced, there will remain, at least in the public's view, a serious concern about the possibility of an environmental disaster due to a major reactor accident. Therefore, wherever such uncertainties can be resolved or addressed, the FES should do so to the extent possible at this time.

3. Two of our original comments in the draft statement dealt with the relative safety of the LMFBR and the LWR. The response to one (which has resulted in the expansion of paragraph 4.2.7.3) is on page VII.53–152 and the response to the other is on page VII.53–154. The main thrust of both of these comments was for a quantifiable comparison of the risks in such a way as to be able to conclude whether the LMFBR is more safe or less safe than the LWR, through the spectrum of the risks from the various conceivable accidents. Paragraph 4.2.7.4. of the PFES does indeed include a comparative table of the features of the LMFBR and the LWR as they pertain to safety. However, quoting from the AEC response on page VII.53–154 ". . . in view of the lack of design detail, however, it is not possible to quantify comparative characteristics of LMFBR's and LWR's.,

It is our objective that LMFBR risks be comparable to those of LWR's. Unfortunately, the accomplished attainment of this objective cannot be proved at this time (though it can be attained). Risk studies for LMFBR's will be performed in the future. becoming more specific and more meaningful as design features are set, so that valid comparisons can be made, not only to LWR risks, but to a wide variety of other risks." It is commendable that the AEC has endeavored to bring the LMFBR risks to a scale comparable to those of the LWR, which we accept as a commitment for future designs. On page VII.53–152, the AEC stated that: "One key comparison is the measure of the ability of the LMFBR to measure up against Regulatory requirements for safety." As indicated in the PFES, the initial approach to ensuring a minimum level of LMFBR safety will be through the use of (1) traditional regulatory safety approaches; (2) existing regulatory (NRC) safety requirements and design guides; and (3) existing "interim" CRBR NRC design requirements. While this approach suffices for the short term, if a breeder based energy economy is to be developed, we believe LMFBR specific design, safety and siting criteria must be developed in a timely fashion.

4. One of the most important considerations regarding LMFBR safety is, of course. the HCDA. The central issue is the amount of energy that is possible to be released in the form of mechanical work in case of a large core disruptive accident. The fundamental safety requirements to be met for such an accident are: (1) it will be contained and the risk of leakage of radioactive debris is acceptably small and (2) recriticality will be avoided. The AEC response on the

HCDA (pages VII.53–156–157) indicates that there will be no direct environmental consequences from such incidents, which is supported by encouraging results from recent research and development. However, we find that the energy conversion efficiency is not well defined. TREAT experimental results that indicate a 0.2% energy conversion efficiency need further justification. If 10% conversion efficiency is accepted for analysis (pages 4.2–152–153), then vessel integrity may not be achievable. This point needs further elaboration. Section 4.2.7.8 has been expanded considerably to include discussion of the HCDA. However, the PFES is deficient in its discussion of pin structural integrity and fuel motion under conditions of or during progression of HCDA's, post accident heat removal, code validation used for predicting core behavior, and on consequences of core voids on neutron streaming.

Because of the great importance of the HCDA and because some experts seem to have reservations on the ability to accurately predict the behavior of the pressure vessel under conditions of such a core accident, ERDA should continue to make every effort to inform the public and other Federal agencies of the state of the current research and development programs dealing with HCDAs as was presented on pages 4.2–147–149 i.e., "This mode of recriticality appears at least conceptually possible in large reactors; planning has begun to evaluate effects of this mode of recriticality . . . it is true that significant uncertainties exist in the analyses of recriticality situations. In large measure, these uncertainties stem from the as yet incomplete research and development program. . . ."

5. One of EPA's comments on the DES dealt with the safety implications of irradiation creep and irradiation swelling of stainless steel used for fuel pin cladding and in the reactor internals. It was recognized in the AEC's response in the PFES (page VII.53–157) that the DES did not ". . . clearly identify the swelling phenomena as a technical area of considerable interest." The response further stated that the PFES ". . . includes specific evaluations of swelling and also includes by reference studies of the safety implications of systems with and without swelling (see for example BAW–1305; cited as Reference 111)."

Because of the importance of this subject to safety we believe that the treatment of irradiation creap and irradiation swelling could be expanded, since we were unable to locate the "specific evaluation" as indicated in the response. The information in the PFES does not include any quantifiable information which would indicate the status of the problem of fuel cladding creep and swelling on core performance and safety as related to potential environmental impacts. Likewise, the information in the PFES does not adequately discuss the safety and economic implications of prospective solutions, such as core clamping, frequent replacement of control rods, etc.

RADIOACTIVE WASTE DISPOSAL

Interim storage and ultimate disposal

On April 10, 1975, the Energy Research and Development Administration (ERDA) announced that they were withdrawing their plans to develop a Retrievable Surface Storage Facility for high level radiactive wastes. ERDA now plans to emphasize the direct development of ultimate waste disposal facilities. We concur with the emphasis on the development of permanent disposal techniques, as we indicated in our comments on commercial high-level waste management (WASH–1539).

Validation of commercial burial grounds

In the PFES and in the AEC's response to our comments, the AEC stated that ". . . to date, there have been no reports of migration of radioactive material from commercial burial sites." This is in error, since radioactivity has been reported to have migrated off-site from burial facilities in Kentucky and New York State. The reported results of an extensive, six-month investigation by the Kentucky Department for Human Resources (KDHR)[3] clearly indicate that the radioactive waste disposal site at Maxey Flats is contributing radioactivity to the environment.

It was concluded by KDHR that the concentrations of radioactivity detected in the off-site environment do not yet constitute a public health hazard; however,

[3] Project report, "6-Month Study of Radiation Concentrations and Transport Mechanisms at the Maxey Flats Area in Fleming County, Ky.," KDHR Bureau for Health Services, December 1974.

the evidence of off-site movement clearly shows that there is a need to intensify current monitoring activities to determine the possible extent and amount of radioactivity which is moving from the site and to assess its long-term significance.

Additional environmental studies supported by EPA, in cooperation with KDHR, support the KDHR findings, and studies of the site hydrogeology by the U.S. Geological Survey (USGS) have identified pathways and mechanisms for this off-site movement of radioactive materials. In December 1974, the KDHR made public a report[6] of their work and a number of local, state, and national news articles about the KDHR report and the migration of radioactivity at Maxey Flats were published in December 1974, and January 1975.

Recent reported findings by the New York State Department of Environmental Conservation have also shown radioactivity levels in surface waters from the Nuclear Fuel Services burial site near West Valley, New York. This site was recently closed by the operator because of this condition.

Additional investigations needed

The EPA is conducting preliminary field investigations at two waste burial facilities in cooperation with the state agencies and the USGS. It has also reviewed available reports on investigations which have been conducted at the other four waste burial facilities. On the basis of this information, we must disagree with the AEC's statement (p. 4.6–46) that sufficient analyses have been performed at the burial facilities which demonstrates that ". . . buried radioactive waste will not migrate from the site." To the contrary, radiochemical analyses from samples collected at the New York and Kentucky burial sites indicate that radioactive wastes have moved from the burial trenches at both sites and, as noted earlier, have moved off-site in Kentucky after only ten to twelve years of burial operations. These two sites were initially licensed under the assumption that they would have the ability to contain the wastes buried therein for hundreds and even thousands of years. Since they are not performing as predicted, we believe that additional investigations are required to determine the ability of all of the present sites to comply with the criterion of no off-site migration.

In the six-month investigation conducted by the KDHR, plutonium was detected in the soil and in monitoring wells in Kentucky. The exact mechanism by which it moved from the trenches has not been determined yet but the important fact is that it has migrated from the trenches in which it was buried, less than twelve years ago. It may be that additional investigations in this area are urgently needed. We believe this is particularly important for any nuclear fuel cycle, such as the LMFBR, which will generate large quantities of plutonium.

Classification of wastes

We appreciate the AEC's efforts in clarifying and reorganizing the classification of radioactive wastes within Section 4.6 of the PFES. However, the AEC apparently did not understand our basic concern about their proposed system of classification. The category other-than-high-level (OTHL) wastes and its sub-categories still do not give sufficient information on the activity, content, and hazard potential of the waste. The classification only indicates (1) that a waste is not high-level waste, (2) whether or not it contains a certain level of alpha contamination, and (3) whether it comes from a certain functional area of the fuel cycle.

A more detailed, explicit classification system is needed to enable reviewers to evaluate the potential environmental impact from the OTHL wastes. Such a system would also be of great assistance to EPA as well as others, such as burial site operators and the state agencies which regulate them. We realize that developing a radioactive waste "classification" system which meets the needs of everyone will be difficult and not necessarily a part of an LMFBR development program. However, we believe that this is an important effort since as shown in a recent EPA report[4] on land burial activities, the problem is expected to grow in the future.

Other comments

In Section 4.6.2.1, the PFES states that, "Radioactive materials in the coolant will consist of fission products and neutron-activated structural materials that are

[4] "Radiation Data and Reports," vol. 15, No. 12, EPA Office of Radiation Programs, December 1974.

released to the coolant by corrosion processes." This statement does not consider the potential for transuranic radionuclides leaking into the coolant from the $PuUO_2$ fuel elements, or the possible disposal difficulties which may arise if the OTHL waste, expected to be disposed of at land burial sites, is found to contain transuranics in concentrations which prohibit its disposal in that manner.

In Section 4.6.3, the PFES states that "The technology and facilities established for management and disposal of radioactive waste from the LWR nuclear power industry will be directly applicable to the management of radioactive waste generated by the LMFBR and its fuel cycle." It has not been adequately demonstrated by the PFES that the technology and facilities established for the processing, management, storage, and/or disposal of waste from the LWR industry will be directly applicable to managing LMFBR fuel cycle waste. It appears that the following areas in waste management may be unique to the LMFBR fuel cycle and may require the application or development of new technologies:

a. Transuranic contamination in the LMFBR low-level waste streams;

b. Organic solvents in the LMFBR liquid waste cleanup system;

c. Radioactive sodium wastes, containing large quantities of radioactive fission products, transuranics, and activation products from neutron activation of core structural components, due to the high neutron flux levels in the LMFBR; and

d. Increased quantities of transuranic contaminated low-level waste at the LMFBR fuel fabrication and reprocessing sites.

PLUTONIUM SAFEGUARDS

The PFES has been greatly expanded in the area of safeguards. The general approach to development of the required safeguards programs is explicitly stated, as are a number of safeguards requirements and subproblems. In general we believe that these changes, along with other refinements in the treatment of safeguards, show a great improvement over the presentation in the DES. The PFES includes a substantial amount of information on safeguards costs—information that was omitted in the DES. This effort can only be viewed as a first approximation of costs; nevertheless, it provides an explicit, intelligent estimate of the safeguards costs. We recognize that making this evaluation involved considerable effort, which was justified, however, by the importance of this aspect of the program.

Costs for safeguards will be high, involving many millions of dollars in capital and operating costs. However, when reduced to a percentage of corresponding total costs for a large "module" of 80,000 MWe capacity, these costs do not represent an excessively high fraction of the total cost, i.e., less than 1 percent of fuel cycle capital costs and less than 2 percent of total operating costs. This is perhaps the best way of looking at these costs. However, it must be recognized that before LMFBR deployment reaches the scale of this module, the corresponding safeguards costs, when expressed as fractions of operating and capital costs, could be considerably higher.

In view of the recent division of the AEC into ERDA and NRC, we strongly recommend that ERDA's FES indicate explicitly which agencies are assigned specific areas of responsibility and authority for safeguards. The safeguards program is of the utmost importance. Difficulties and possible gaps in the development of the program can be avoided by an explicit assignment of responsibility and authority from the start. Additionally, ERDA's FES also should indicate the organizational structure within each of these agencies where these duties reside.

PLUTONIUM TOXICITY

The PFES recognizes that with respect to plutonium toxicity the answers to some important questions concerning the impact on public health are not available. It is recognized by EPA and the AEC that in many cases there are reasonable differences of opinion on the health implications that might be inferred in the absence of definitive data. While it is agreed that animal toxicity experiments, and not the meager human exposure data, should serve as a guide, the discussion of animal data is not sufficient to allow a judgment to be made on plutonium toxicity in man. The differences of opinion on the significance of animal data extrapolated to man are unresolved.

Although the toxicity of plutonium may be underestimated by an order of magnitude, adjusting the adverse health effects estimates upward by an order of magnitude would not significantly change the total health impact of the MFBR program as estimated by the AEC in the PFES. This is because the projected releases of plutonium are so small. As new data become available during the development of this technology, any significant changes that may occur in the assumed probability and magnitude of plutonium releases into the environment from the LMFBR fuel cycle would require a re-evaluation by the EPA on the health impacts due to the LMFBR program. Health effects have been forecast on the basis of what is essentially a zero release operating philosophy. It remains to be seen whether near zero release is technologically possible and whether all important plutonium releases, such as those due to sabotage, have been properly considered.

TRANSPORTATION SAFETY

The PFES does not provide the bases for the quantification of the risks associated with transportation accidents, which EPA previously requested; rather, risk values were based on assumptions and judgments. To our knowledge, the relationship between packaging test requirements and the survival (or maintenance of integrity) of such packages under various accident conditions has not been established. This consideration applies to transportation of all types of radioactive material.

Although we failed to address this issue in our comments on the DES, we note that AEC suggested that the doses estimated from spent fuel transportation accidents could be compared to the "accident guidelines" set forth in 10 CFR Part 100. The stated purpose of 10 CFR Part 100 was to provide criteria to guide the nuclear industry in evaluating the suitability of proposed sites for LWR's, and the AEC indicated that its use of the values of 25 rem to the whole body and 300 rem to the thyroid is not intended to imply that these values constitute acceptable limits for emergency doses to the public under accident conditions. In our opinion, it would be more appropriate to compare the transportation accident doses to the LD 50/60 dose-response curve.

CONSIDERATION OF NUCLEAR ALTERNATIVES

Alternatives to the LMFBR were presented in Section 6 of the PFES. These alternatives are, in cost cases, treated in an even-handed manner for comparison with the LMFBR. However, this section needs to have included in its summary a side-by-side comparison of the more viable alternatives, perhaps in tabular form. This comparison should emphasize the significant advantages and disadvantages of the alternatives (e.g., apparently the principal disadvantage of the GCFR is its later introduction date).

FWPCA PERMIT CONSIDERATIONS

EPA will be responsible for issuance of discharge permits for the proposed (LMFBR) power plants, under the National Pollutant Discharge Elimination System (NPDES)—Section 402 of the Federal Water Pollution Control Act of 1972, as amended (FWPCA). Issuance of the permits will be based upon review and analysis of all relevant information supplied by the Applicants. Consideration will be given to requirements of Section 301 and 316(b), and all other provisions of the Act.

Section 301 of the FWPCA stipulates that effluent limits for various point source discharges to navigable water shall require the application of "Best Practicable Control Technology Economically Achievable" no later than July 1, 1977, and "Best Available Technology Economically Achievable" no later than July 1, 1983. The levels corresponding to those terms were defined in EPA's Steam Electric Power Generating Point Source Category Effluent Guidelines and Standards, Federal Register, of October 8, 1974. Section 316(b) of the FWPCA requires that ". . . the location, design, construction, and capacity of cooling water intake structures reflect the best technology available to minimize adverse environmental impact."

Section 306 of the Act further modifies effluent limits for new point sources requiring that "... discharge of effluent reduction which the Administrator determines to be achievable through application of the best available demonstrated control technology, processes, operating methods, or other alternatives including, where practicable, a standard permitting no discharge of pollutants." "New source" means any source, the construction of which is commenced after the publication of proposed regulations prescribing a standard of performance under this section which will be applicable to such source, if such standard is thereafter promulgated in accordance with this section. The term "source" means any building, structure, or facility from which there is or may be the discharge of pollutants. An exception to these new point sources is any construction work contracted prior to publication of the new proposed regulations.

Chairman HUMPHREY. That was a full text of the documents to which you referred. Now, what you really said to us, in a way, is that we face a choice between the breeder reactor with all of is problems and very expensive mining, including strip mining, of uranium and coal and the air pollution associated with coal burning. Is that right?

Mr. MEYERS. That is right.

Chairman HUMPHREY. Thus, the Environmental Protection Agency faces an array of unpleasant alternatives and all have their own problems. Have you considered the alternatives?

Mr. MEYERS. Have we considered them?

Chairman HUMPHREY. Yes.

Mr. MEYERS. Only insofar as we can through analysis of the impact statement prepared for the LMFBR. We have not done a separate analysis to decide for ourselves which are the better energy options.

Chairman HUMPHREY. But you have really come to the judgment that the breeder reactor, with all of its problems, is preferable to more extensive mining and utilization of uranium and coal?

Mr. MEYERS. I didn't hear your question.

Chairman HUMPHREY. I said, in other words, you have posed the choice for the country between the breeder reactor with all its problems as compared to extensive mining, including strip mining, of uranium and coal and the air pollution associated with it?

Mr. MEYERS. That is right. We clearly say in our comments that one should not stop but rather should analyze the alternatives available at this stage in the development of the LMFBR.

Chairman HUMPHREY. But time and again throughout your report you argue that the breeder program could stand a 4- to 12-year delay without significantly reducing its uranium conservation value. In your cover letter you say as follows:

> For example, using the latest demand projections of Project Independence, our preliminary analysis indicates a delay of 4 to 12 years might be accommodated without significantly reducing the uranium conservation value of the breeder.

My question is, what is the probable impact of, let us say, a 4-year program delay in the uranium conservation value of the breeder reactor? What would be the impact of 8 or 12 years?

Mr. MEYERS. When you say "impact", impact on what? Do you mean the economy, the environment?

Chairman HUMPHREY. What would be the impact upon conservation of uranium?

Mr. MEYERS. Well, first we distinguish between the research and development program and what is called commercialization.

Chairman HUMPHREY. Yes.

Mr. MEYERS. We feel that, since, at some point in time, one runs out of fossil fuels, it is wise to embark on a research and development program of this kind. However, whether or not you introduce the LMFBR with the timing proposed by the AEC, assuming it gets developed on a reasonable schedule—that is the question we raised.

In other words, the breeder's case is partially based upon using up the available uranium supply. I believe the figures used by the AEC were some 2.4 million pounds available at both identified and prospective sites. But if one will not be using energy as quickly as we had thought, then a delay in introducing the breeder reactor would not reduce the uranium resources that are still there.

Chairman HUMPHREY. In other words, if electrical consumption is less, as you would anticipate—in other words, if a smaller amount of electricity is used than was anticipated by the AEC or ERDA—then you feel that a delay in the breeder reactors would not be hazardous or would not endanger us?

Mr. MEYERS. Oh, if that did indeed happen—that is, if the demand dropped or continued not to increase at the rate that has been presupposed by the AEC in making their calculation—yes.

Chairman HUMPHREY. You think the uranium supplies are sufficiently plentiful to weather a 4- or 8-year delay in the introduction date of the breeder reactor?

Mr. MEYERS. Again, only if the demand growth for electricity is lower than that which has been anticipated or projected by the AEC.

One factor has not been woven into all of this is the conservation effort. There has been no talk of it. ERDA does have a staff responsible for conservation efforts, and such efforts might contribute to lessening the demand for electriicty. It is just an unknown factor at this time.

Chairman HUMPHREY. Might I say that, looking over your statement—and we had a chance to study it ahead of time—looking at your study of demand for electricity, you suggest that it will grow at a rate of between 5.2 percent and 4.7 percent annually. The breeder impact statement assumes a growth rate of 5.7, which is only one-half to 1 percent higher.

Now, your figures are based on the growth in energy to produce electricity in the future and not on the amount of electricity actually produced in terms of kilowatt hours. Our staff here of the Joint Economic Committee examined the demand for electricity in kilowatt hours in order to check on your results and I can tell you the results of our study confirm your assumption, that is, that the most recent demand projections for electricity show that it will grow at a lower rate in the future than in the past.

In fact. our staff found that the most recent projections of demand for electricity show that it may be 1 to 1½ percent lower than was projected in the breeder impact statement.

I have to confess that our analysis may not be as thorough as some that might be developed by agencies with a much bigger and more technically refined staff. But, if we have a growth of 1 to 1½ percent lower than projected, what length of delay could we afford in introducing the breeder in terms of uranium resources and other important issues?

Mr. MEYERS. I can't answer that, Senator.

Chairman HUMPHREY. But, delay you think is desirable and feasible. It is feasible, obviously. But desirable?

Mr. MEYERS. Again, remember we have differentiated between the actual development of the LMFBR as a concept and so-called commercialization. My own feeling is that, once it is developed and let us assume it is, the commercialization will take place when it becomes economically feasible; when it is cheaper than anything else around whether it be light-water reactors, coal plants, or other fossil fuel plants. This is essentially the way the light-water reactors became commercial.

Chairman HUMPHREY. So what you are saying is that the Government could go right ahead with the demonstration project regardless of what the electrical demand is just to have the project tested, so to speak, to have it ready and available if there was the need for the electricity?

Mr. MEYERS. It is clear that the demand for electricity is rising. It just doesn't happen to be rising as fast at the rate projected but it is rising. And recognizing that there are limited supplies of fossil fuels and uranium, it makes sense to me to have the LMFBR concept developed to the point where it can be commercially introduced when it is necessary.

Chairman HUMPHREY. This is such an essential point, I am going to keep bearing down on it because I want to explore your mind on it. Commercial introduction in the use of a breeder reactor for utilities is scheduled under the present developmental schedule by 1987. I guess that is a date that was picked, assuming that electricity demand will grow at historic rates.

Now, as has been indicated, with the oil embargo, with the jump in oil prices, the jump in electrical rates has moderated the growth in electrical demand. I think we have to be somewhat careful here because we are going through a recession too at the same time. Now, this may throw all of these patterns out of paper relationship or focus.

But utilities have recognized some reduction in demand and are canceling or deferring plant additions at record rates. Over $30 billion in planned capacity additions have been canceled or delayed.

Now I might add that I think one of the reasons for that is the high cost of money and the uncertainty, of course, of the future cost of money. It can't be related only to what is looked upon as the reduced demand for electrical energy, but it is one of the factors.

Anyway, as the result of these higher prices and conservation efforts, it is now predicted by Electrical World, and that is the central publication of the electrical utilities, it is now predicted by the Edison Electric Institution and by the FEA that electricity demand will be 25 to 35 percent below expected levels in the future. That is their prediction.

Your report suggests that this moderated growth in electric demand means that we can delay introducing the breeder beyond 1987; is that correct?

Mr. MEYERS. That is what it infers, yes.

Chairman HUMPHREY. That is what it infers? Your report is a critique of the breeders' environmental impact statement prepared in December of 1974. In that statement, the present breeder schedule was based on electric demand growing at historic rates, at rates now considered too high, a fact known last year.

Now, did ERDA ignore this new evidence, namely, the moderation of the growth of electric demand in preparing the breeders' impact statement?

Mr. MEYERS. Remember that ERDA did not prepare the statement. The title of that statement is "A Proposed Final Statement" and the reason it is titled that way is to give ERDA an opportunity to go over the information that was put together, essentially by the AEC.

Chairman HUMPHREY. Really, you might say the draft statement was AEC's; and ERDA, being a new organization, accepted that draft statement and now is going to go over it and get a new critique?

Mr. MEYERS. They have wisely put it out in proposed form. The normal route would have been to put out a final statement after the draft. Of course, the proposed fiinal statement was essentially finished by the time ERDA was formed. And I think they wisely agreed to put it out for public review. In view of the fact that the Energy Research and Development Administration is responsible for a broader range of energy options than the AEC was. Presumably ERDA will bring a different perspective to the final environmental statement for the LMFBR when it is published.

Chairman HUMPHREY. Now, concerning the point in your report where you say the purpose of the sensitivity analysis, requested by you, from ERDA was to investigate the degree to which the projected benefits of the breeder reactor would change with different assumptions about uncertain future conditions.

In particular, EPA believed that energy demand in the year 2020 could be 50 percent smaller than that projected, using the base projections.

You say that the uranium supply could be significantly greater than that projected for the base, and that the capital cost differential between the breeder and the light-water reactors could be significantly higher than the base projection, and so on.

Now, given ERDA's estimates in these crucial areas, varying significantly from EPA's, would it be wise to postpone funding to the Clinch River Reactor until ERDA can better support its estimates? Because you people, you know, come to significantly different conclusions on these issues.

Mr. MEYERS. They prepared their estimates on their assumptions and we on ours. Frequently, as we said in the letter, reasonable people can differ.

Chairman HUMPHREY. Did you ever think about getting together to agree upon the assumptions?

Mr. MEYERS. We have tried to do that. We worked very closely with them in trying to help them put together the proposed final statement. There are some areas where, you know, they feel they have to go their way and we feel we have to go ours. I don't recall whether these differences were on this particular issue.

But, with regard to whether one ought to delay the work on the Clinch River Reactor, I think not.

Chairman HUMPHREY. You know, there are significant differences here. We are talking about the public's money. We are not talking about chickenfeed either. We are talking about, totally, some $10.7 billion. Isn't that a lot of money, even in Washington? And without counting inflation, too.

There is a great difference between your estimates and those of ERDA; a tremendous difference. My question is specifically with reference to these costs, Mr. Meyers, would it be sensible to postpone funding to the Clinch River Reactor until ERDA can better support its estimates or prove that you are wrong?

Mr. MEYERS. We did not make independent estimates of the capital costs of LMFBR's into the future. What we asked ERDA to do was to revaluate the numbers they came up with.

Chairman HUMPHREY. Yes, and what have they done?

Mr. MEYERS. They have not addressed that question which we raised in our comments.

Chairman HUMPHREY. Now you are asking them to reevaluate it? In the meantime, we are going down the road with the project.

Mr. MEYERS. It is possible ERDA, when they put out the final statement, will address it. We have raised it again in our comments on this proposed final statement. The R. & D. program that comes before the Clinch River plant should go on, very definitely. If the people who are running the program have sufficient confidence in the results so that the next step would be the Clinch River demonstration plant, then I believe that demonstration plant should follow.

Chairman HUMPHREY. You see what I am worried about is, I went through the SST operation. I was chairman of the Space Council for 4 years. I had one of the toughest decisions of my political life when I came back to the Senate as to whether we should keep pouring money into the SST or whether we should chalk it off after having spent almost $1 billion. That was $1 billion of the people's money. And yet, had we gone on, maybe it would have cost another $400 million in round numbers to have completed the prototype. But, once you get involved in these things, they have their own momentum.

Mr. MEYERS. I understand.

Chairman HUMPHREY. And I am just wondering whether or not we ought not to stop and look and listen. There was one old friend of mine in the Senate years ago, and I won't mention his name, but somebody asked what he ever did. You know, everybody is critical of Senators and Congressmen, and we are critical of other agencies. And somebody asked, "What good does this man ever do for the country?" And a good friend replied, "He always says to wait a minute and take another look." And that looking and waiting may have saved the taxpayers billions of dollars. Of course, he might have caused some undue delays.

I am a man who believes that we ought to move forward in these programs. But it is a question of whether we move with the appropriate timing and whether we get the most for our dollars.

Now, does there seem to be a bias in ERDA for or against the breeder reactor?

Mr. MEYERS. Mr. Seamans will be certainly in a better position to tell you—but I think the law required that they balance out the management of ERDA with people from other than nuclear backgrounds. I don't think that Mr. Seamans is disposed towards going on with the LMFBR's irrespective of what the facts tell him. I am sure he will give it a very careful review when it comes up to him for a decision, but I don't know what he is going to do. ERDA is composed, as you well know, in large measure of AEC personnel.

Chairman HUMPHREY. Yes, that is right. The impact statement was really an AEC sttatement, mostly. Now, do you think it had any bias?

Mr. MEYERS. I think it was a good job.

Chairman HUMPHREY. You think it was a good job?

Mr. MEYERS. They did a good job in terms of laying out the program with the information they had. Remember, we are talking about some things that go into the future.

Chairman HUMPHREY. Yes, I realize it is very difficult.

Mr. MEYERS. The AEC, in general, has done agood job in preparing the environmental statement on all their plants. The LMFBR statement was of great magnitude. I think they did a good job, and whatever bias is there just gets woven in by virtue of their interest in the program.

Chairman HUMPHREY. At what point does the capital cost differential between reactor and the light-water reactor approach a critical state at which the breeder ceases to be economical, and is the capital differential nearing that point?

Mr. MEYERS. I don't know. I can find out for you.

Chairman HUMPHREY. By the way, we will send you a couple of questions that need to be answered in writing. I think that is one that we might want to ask some more information on.

Now, the possibility of a higher future price of uranium may influence what we pay for a breeder reactor to conserve uranium. Have you or anyone tried to quantity how much the breeder is worth in this sense as a function of future uranium supply and prices? Do you get my point?

As the price of uranium goes up, of course, the cost of fuels for your light-water reactor goes up. A moment ago, GAO pointed out that fuel was not the most important item in nuclear generations, but——

Mr. MEYERS. I agree with Mr. Hughes that the fuel cost itself compared to the processing that goes along with in the fuel cycle is not all that important. One can have a relatively higher cost of the uranium itself as long as the associated cost of reprocessing it remains constant or doesn't escalate as high.

Chairman HUMPHREY. Isn't the main argument for the breeder the possibility of the scarcity of uranium and, of course, scarcity automatically means price increases?

Mr. MEYERS. Remember, for the light-water reactors you have to have what is called an enriched ore.

Chairman HUMPHREY. Yes.

Mr. MEYERS. In other words, the part of the fuel capable of fission is the U^{235}, which appears in 0.7 percent of the high-grade uranium ore; that means the other 99.3 percent of the naturally occurring uranium is U^{238}. And it is this part that can be used in the LMFBR.

In other words, there are mounds of U^{235} lying around right now that can be taken advantage of without undue mining in the early stages.

Chairman HUMPHREY. It is sort of like in Minnesota after mining the high-grade iron ore, they went back to the pits and utilized the low-grade ore. And now we are using taconite, which is the low-grade ore.

Mr. MEYERS. Except in this case, you don't even have to mine it. It is already there and ready to be used.

Chairman HUMPHREY. We also have what we call low-grade ore that lies around that was just stripped off the top. It is sort of like kids getting watermelons when there is a truckload. Did you ever do that?

Mr. MEYERS. Yes.

Chairman HUMPHREY. You just go in and get the heart of the watermelon. It is great fun. Oh, what pleasures we once had.

Let us see if I have a couple of other questions I ought to put to to you. In your report, you say:

In view of this volatility of the net benefits with respect to uranium supply, it would appear desirable to collect more information on uranium supply before making a total commitment to pursue the net benefits of the LMFBR program.

In light of that statement, can Congress afford to wait 5 years until the ERDA project to develop improved uranium reserve information is completed before funding the Clinch River Reactor?

Mr. MEYERS. Again, I think not. Now, EPA is talking about, in my view, when the breeder gets introduced, that is the commercial plant. The Clinch River plant is part of the R. & D. program. In other words, the R. & D. program leads to a demonstration plant and without that plant there are always questions of whether or not it works the way it is supposed to. So, I don't think one ought to delay the Clinch River plant.

Chairman HUMPHREY. I've got a couple of other questions, but because time is running short, we will have the staff send you an inquiry by letter and in due time you can reply.

Mr. MEYERS. I would be delighted to.

Chairman HUMPHREY. I want to thank you very much. Your testimony again has been helpful. We are just exploring here and that is all. Thank you so much. Also, give our regards to Mr. Train.

Our next witness is Mr. Theodore Taylor, International Research & Technology Corp. Mr. Taylor is a distinguished nuclear scientist, who had worked for a number of years in the nuclear weapons program.

Doctor, I am happy to say hello to you today. You are widely recognized as one of our foremost experts on the safeguard problems of nuclear materials. May I say, Doctor, that is an enormous problem as we move toward the breeders and plutonium economy. In fact, I have had a special interest in the transportation of these materials. I am most grateful that you have been willing to take some time today and come to testify.

Go right ahead and proceed with your statement and forgive the committee for keeping you here so long. I am afraid we overscheduled here, as usual.

STATEMENT OF THEODORE B. TAYLOR, CHAIRMAN OF THE BOARD, INTERNATIONAL RESEARCH & TECHNOLOGY CORP.

Mr. TAYLOR. That is perfectly all right. Thank you very much, Mr. Chairman. My prepared statement is rather short and I would like to read it, if I may.

I greatly appreciate the opportunity to testify at these hearings on the liquid metal fast breeder reactor (LMFBR) program.

The aspect of the LMFBR program that I would like to focus attention on in my testimony concerns the safeguarding of the components of LMFBR fuel cycles against sabotage designed to release dangerous quantities of radioactive materials, and against clandestine or overt theft of plutonium for subsequent destructive purposes.

The majority of my statement is a brief summary of highly preliminary estimates of the costs of providing effective safeguards against these risks, not only for LMFBR fuel cycles, but also for current types of light water reactor (LWR) fuel cycles that account for practically all the present U.S. nuclear power production; LWR fuel cycles in which plutonium produced in the reactor is separated from fission products and uranium in spent fuel and subsequently recycled; and high temperature gas cooled reactors (HTGR) that use highly enriched uranium for fuel. These estimates, and the basis for them, is presented in some detail in the proposed final environmental statement on the LMFBR program—WASH-1535—published by the Atomic Energy Commission in December 1974.

I have three tables from that AEC report that deals with safeguards and if the chairman will permit me, I would submit them for inclusion in the record at the end of my testimony.

Chairman HUMPHREY. We welcome that.

Mr. TAYLOR. Before summarizing these cost estimates, I shall make several brief points about the need for safeguards and about safeguards related comparisons between the LMFBR and other nuclear fuel cycles.

First, given roughly 10 kilograms—roughly 20 pounds—of reactor-grade plutonium oxide or about 20 kilograms of highly enriched uranium oxide, and using information that is widely published and materials and equipment available from commercial sources, it is quite conceivable that a criminal or terrorist group, or even one person working alone, could design and build a crude fission bomb that could be carried in a small automobile and that would be likely to explode with a yield equivalent to at least 100 tons of high explosive. Such an explosive in an especially densely populated area, such as Lower Manhattan, could kill more than 100,000 people.

Second, although the present rate of production of plutonium in U.S. power reactors is already very large—more than 5,000 kilograms per year—no commercial nuclear fuel reprocessing plants for separating this plutonium from fission products and uranium are operating in the United States, nor are any expected to start operations until at least a year from now. I would say this is at the earliest. Until this happens, the plutonium in the unprocessed fuel will not only be very dilute, and in a form not usable in fission explosives without chemical separation, but also will be impressively "self-protecting" because of the intense highly penetrating radioactivity of the contained fission products.

This situation will change markedly when fuel starts being reprocessed, and the separated plutonium is extracted and stored as plutonium nitrate solution. The chemistry for conversion of this solution to plutonium oxide, which could be used directly in a fission bomb, is straightforward and widely published. Since even minute quantities of plutoniums are toxic, especially if they are inhaled, such an operation can be done safely only if people working with the material are protected from the plutonium by some kind of air-tight barrier. But heavy shielding is not required.

Third, the time at which any commercially extracted plutonium nitrate will be converted to plutonium oxide powder, for subsequent incorporation into fresh fuel for plutonium recycling is uncertain, and depends to a large extent on the timing of decisions by the Nuclear Regulatory Commission (NRC) concerning additional safety and safeguards related regulations that may be imposed on recycled plutonium. The earliest time at which plutonium may be routinely recycled in the United States is about 1979—and I should say even if the decision were made essentially tomorrow that would be so. The reason for that is, it is going to take about 3 years to build the first large commercial plant that can take this plutonium oxide and recycle it into fresh fuel.

Fourth, present safeguards applied to plutonium that was commercially extracted through early 1972, when the Nuclear Fuel Services reprocessing plant in western New York shut down for expansion, are not adequate to prevent theft by heavily armed groups with resources and motivation comparable to the Brinks gang and other groups of professional criminals that have carried out successful major robberies in the past. Systematic studies are now being carried out by NRC, however, and also by ERDA, to determine the comparative costs and benefits of a wide variety of possible more stringent physical security and materials accounting measures. These studies are likely to provide much of the information required for further NRC decisions concerning regulations.

Now, to get to the LMFBR directly, my fifth point is the primary differences between the fuel cycles for the LMFBR and LRW, with plutonium recycle, as far as the need for safeguards against the theft of plutonium are concerned, are quantitative as a matter of numbers, rather than qualitative, assuming the same siting policies are adopted for all the fuel cycle components in both cases. By this I mean that the chemical and physical forms of plutonium present at all stages of both fuel cycles are roughly the same.

For the same total electrical power generated by the fuel cycle, however, an LMFBR system involves roughly six times as much plutonium as the LWR fuel cycle, and the plutonium concentration of fresh LMFBR fuel is two or three times the plutonium concentration in presently planned mixed PuO_2, UO_2 fuel rods for LWR reactor fuel assemblies.

Sixth, the individual vulnerabilities to sabotage of LWR and LMFBR reactors and other fuel-cycle components containing large inventories of radioactive materials are not described in any detail in public reports. I understand that studies of this subject are currently underway in the Energy Research and Development Administration (ERDA), and to some extent in NRC. Except for observing that some of the safeguard measures that were assumed to be applied to the future to the fuel cycles compared in WASH–1535 were to deal with attempts at sabotage, I shall not deal with this subject in my testimony.

I should say that the reason for that is that it seems prudent not to discuss publicly in any detail just what one might do graphically to undertake an act of sabotage that would release very large amounts of radioactive material from a nuclear powerplant.

Tables 7.4–15, 7.4–16, and 7.4–17, taken from WASH–1535, which I referred to previously, summarize the safeguards-related characteristics of LMFBR, LWR—with and without plutonium recycle—and HTGR fuel cycles; the assumed numbers of physical security personnel assigned to each fuel-cycle component; and the estimated capital and operating costs for each fuel cycle.

The overall conclusions from these estimates are the following:

One, although the absolute capital and operating costs of stringent safeguards measures assumed to apply to a large, future, 80,000 MWe LMFBR fuel-cycle module are large, that is, nearly $100 million annually in operating costs, they represent only about 1.4 percent increase in the cost of electricity produced by the module, assuming a cost of nuclear electric power of 13 mills per kilowatt hour.

Well, let me say I have included a set of tables taken from WASH–1535 that summarizes not only the safeguards-related characteristics of the LMFBR, the light-water reactors and high-temperature gas-cooled reactor fuel cycles, but also the assumed numbers of physical security personnel assigned to each fuel-cycle component and the estimated capital and operating costs of safeguards for each of the four fuel cycles that were compared. The overall conclusions from these estimates are the following, and I have already read the first.

Two, in spite of the considerably greater annual throughput of plutonium for an LMFBR fuel cycle than for an LWR fuel cycle with plutonium recycle, the costs of equivalent safeguards applied to the fast breeder are only about 40 percent greater than for LWR.

I should emphasize that these are highly preliminary estimates, and refer to considerably more stringent, much more stringent, physical security safeguards than are currently called for by NRC regulations. Considerably more detailed cost data can be expected to result from much more detailed NRC and ERDA studies now underway.

I want to reemphasize that in these cost estimates there was a serious attempt, if you will, to put in a few picture windows in advance, going way beyond what is now called for by the regulations.

Let me give you a couple of examples of what I mean by all of this. The present regulations allow the transport of plutonium oxide power from which nuclear bombs can be made directly by truck with an escort, with two armed guards, and with some kind of radio-telephone communication which doesn't have to be constant with the outside world. What was assumed in these cost estimates was quite different, and that is that the plutonium oxide would be shipped by rail in very heavy casks, I mean casks weighing in the order of 100 tons, and not only with accompanying security personnel—I believe it was a dozen per shipment, whereas the present regulations actually in force call for only two—but also with a rather large number of reserve physical security people managing the communications systems and so on, and available to intercept a fairly heavy attempt at a theft.

I don't think that I can say too strongly that these are not now called for, and I don't want to give the impression these types of safeguards are called for now, but they were used as examples in the revised version of the LMFBR statement.

I also would like to say the revised LMFBR statement, as far as what it said about safeguards was concerned, was very different from the original draft. In fact, there was a flood of comments about the original draft in that its treatment of safeguards was just totally inadequate. The subsequent draft, I think, was a huge improvement, and that is one of the reasons I suggested it be put in the record.

That concludes my statement. I will be glad to try to answer any questions you may have.

Chairman HUMPHREY. The tables you referred to in your testimony will be made a part of the hearing record.

[The tables follow:]

TABLE 7.4-15.—COMPARISONS OWF LMFBR, LR, AND HTGR 80,000-MWe MODULES

	LMFBR	LWR w/o Pu recycle	LWR with Pu recycle	HTGR
Power stations	20	20	20	20
Fuel reprocessing plants	1	1	1	1
SSNM fabrication plants	1		1	1
Plutonium storage facilities		1		
High-enrichment isotope separation plants				1
Annual separated plutonium output (kilogram per year)	134,000	17,000	22,000	~80
Rate of shipment of plutonium for recycling through module (kilogram per year)	117,000		22,000	
Annual highly enriched uranium input (kilogram per year)				30,000
Annual separated U-233 output (kilogram per year)				14,000
Rate of shipment of excess plutonium to other modules (kilogram per year)	17,000	17,000		80
Total fixed sites that contain unirradiated SSNM	22	2	22	23
Mode of shipment of fresh fuel assemblies containing SSNM	(*)		(*)	(*)
PuO_2 shipments per year	233	30	38	1
U-235 O_2 shipments per year				18
U-233 O_2 shipments per year				25
PuO_2+UO_2 shipments per year (as rods)			48	
SSNM fuel assembly shipments per year	1,840		†460	944
Irradiated fuel shipments per year	2,140	766	766	944

*Rail, in spent fuel casks.
†Based upon PWR/BWR ratio of 2/1, where all BWR assemblies and 40 percent of PWR assemblies contain Pu.

TABLE 7.4-16.—SECURITY PERSONNEL FOR SAFEGUARDING DIFFERENT 80,000-MWe MODULES

	LMFBR	LWR w/o Pu recycle	LWR with Pu recycle	HTGR
Security personnel per:				
PuO_2, U-235 O_2, or U-233 O_2 shipment	12	12	12	12
Fresh fuel shipment containing SSNM	3		3	3
Irradiated fuel shipment	2	2	2	2
Total security personnel employed for:				
PuO_2, U-235 O_2, or U-233 O_2 shipments	154	20	25	29
Fresh fuel shipments containing SSNM	310		75	155
Irradiated fuel shipments	235	84	84	104
Security personnel at:				
Powerplant	6	4	5	5
Reprocessing plant	12	8	8	8
Fuel fabrication plant*	24	4	12	16
Plutonium storage facility		12		
Isotope enrichment facility*		6	6	12
High-level waste facility	4	4	4	4
Total security personnel employed for:				
Powerplant	600	400	500	500
Reprocessing plant	60	40	40	40
Fuel fabrication plant*	120	20	60	80
Plutonium storage facility		60		
Isotope enrichment facility*		30	30	60
High-level waste faciltiy	20	20	20	20
Total security personnel for transport	699	104	184	288
Total security personnel at fixed sites	800	570	650	700
Total security personnel	1,499	674	834	988

*Includes low-enriched uranium fabrication and enrichment facilities for LWR.

TABLE 7.4-17.—COSTS OF SAFEGUARDING DIFFERENT 80,000-MWe MODULES

[Millions of 1974 dollars]

	LMFBR	LWR w/o Pu recycle	LWR with Pu recycle	HTGR
Capital costs:				
Powerplants	156.0	75.0	120.0	100.0
Reprocessing plant	13.0	8.0	8.0	8.0
Fuel fabrication plant	21.0	5.0	15.0	15.0
Plutonium storage facility		10.0		
High-level waste repository	51.0	51.0	51.0	51.0
Isotope enrichment plant		5.0	5.0	8.0
Other fixed sites	10.0	10.0	10.0	10.0
Transportation	15.0	5.0	7.5	10.0
Total capital costs	273.0	169.0	216.5	202.0
Operating costs (per year):				
Security personnel	45.0	20.2	25.0	29.6
Fixed charge on capital investment at 16 percent	42.7	25.4	34.5	32.4
Regulatory operations	4.0	3.0	4.0	4.0
Other	5.0	4.0	5.0	5.0
Total operating costs	96.7	52.6	68.5	71.0

Chairman HUMPHREY. I have some questions for you that we have prepared as we got ready for your testimony today.

Mr. Taylor, in light of your testimony here, would you cite some more of your findings of safeguards problems from your original survey of nuclear facilities? I understand you are currently making a new survey. Have improvements been significant and are they adequate?

Mr. TAYLOR. Yes; if I may, I would like to go back quite some time to give some indication of how things have changed and also, to some extent, how they have not changed.

In the summer of 1966, I visited several commercial facilities that were processing plutonium and highly enriched uranium, which were not part of our Military Establishment at all, and found that at the facilities I visited there was practically no physical security protection. Now, by that I mean that in the typical installation—and I think this is a fair sample of the situation in 1966, which is almost 10 years ago—there was one security guard at the main gate in one case at least 100 yards from a vault that was open and had within it about 200 kilograms of metallic, fully enriched uranium, which could be used for making explosives. No other security people were on the site and there were no alarms on any of the floors and no detectors of special nuclear material at the doorways.

It was on the basis of this kind of observation, plus the fact that, unfortunately, nuclear weapons are easy to make and a lot easier than most people, at least, thought in those days.

Chairman HUMPHREY. I understand too that the Kerr-McGee situation occurred only shortly after the AEC made an inspection of the safeguards system at Kerr-McGee?

Mr. TAYLOR. Yes, now the Kerr-McGee situation is complicated and bizarre. I know of no evidence that quantities of plutonium left the plant, that is, that sufficient quantities got out of the plant to have anything to do with building a bomb. The *Karen Silkwood* case involved contamination of herself only. Now the fact that that happened is, I think, troublesome, and the fact that there are mismatches fairly often in the material balance accounts for places like Kerr-McGee that handle relatively large quantities of plutonium is also a cause for concern. The fact that the accounts don't match sometimes within a weight that is enough to make several bombs is just a fact of life that has to do with the accuracy of the measurements and the ability of people to monitor how much is actually going through.

Chairman HUMPHREY. There could be a weakness in the system of monitoring and measurements, in other words?

Mr. TAYLOR. Yes; there is a weakness in measurement. I think that is going to be with us essentially forever, that is, measuring what goes in the plant and what goes out of the plant and what is in the inventory of a high-volume production facility accurately enough to see losses that might be enough for at least one or two nuclear weapons. I think that is certainly beyond the present state of the art.

It is for that reason that I think what is called for is much more physical security that will make it much more difficult for people to get their hands on this material. Now, detecting a loss through materials accounting 2 months after it happened is not useless, but it doesn't prevent it from being lost. It may deter, but not prevent.

Chairman HUMPHREY. In the instance of the Kerr-McGee situation, I was led to understand that the AEC found that certain quantities of plutonium disappeared and were somehow smuggled out of the Kerr-McGee plutonium production plant in Oklahoma. Our staff indicated to me that the employees at the plant have said that it is relatively easy to get quantities of plutonium out of the plant. Is that what you mean by the fact that the protection facilities are not up to what they ought to be?

Mr. TAYLOR. Yes; now I should say the protection facilities at the plants I have seen recently are much better than they were even 2 years ago or 2½ years ago.

Chairman HUMPHREY. I wouldn't want to indicate that the employees said anything had happened like this, but that it could.

Mr. TAYLOR. Yes. If they, for example, wanted to steal material, I heard this consistently from people that worked in these plants through the present time, Senator, that they could. This is getting much harder to do now than it was 2 to 2½ years ago.

Chairman HUMPHREY. But this plant was shut down three or four times in 1974 in an attempt to find missing or unaccounted-for plutonium?

Mr. TAYLOR. Yes. And I have no reason to question that. I have heard that said a number of times. Kerr-McGee is not unique in that respect. There have been other facilities that handle highly enriched uranium or plutonium which have not abided by the present regulations. I don't know, offhand, of any instance of a plant actually being shut down, but other than Kerr-McGee, regulations have been violated. I am quite certain of that.

Chairman HUMPHREY. My point was this was 1974, and even in 1974 there were three occasions when, in an attempt to find missing or unaccounted-for plutonium, the plant had to be shut down. This indicates that even as late as 1974 the safeguards are still inadequate?

Mr. TAYLOR. I agree with that completely. They are much better than they were 2 or 3 years ago, but I look at it this way, Senator. This is a little bit like saying you want to enter a horse into a horse race and you start with a horse that can't walk. Then you improve the situation by using a horse that walks but can't run. You will never win the race.

I think we have very far to go in improving the security of these materials to the point where most of us in this room would be able to look at the situation and say "Yes, sir, that looks well protected." We have a long way to go.

I think we can do this technologically and economically. One of the reasons I have gone into a little bit of detail on the cost of the safeguards is that this cost does not seem to be the barrier to good safeguards that people think. The problems, I think, are institutional and perhaps political.

Chairman HUMPHREY. Yes.

Mr. TAYLOR. And one reason I say that is that, at least 10 years ago, there were a number of very strongly stated objections to the safeguards program in the United States, and the situation then was very bad and was recognized as being very bad. Then 1966 is the first time I am aware of that this was dispersed into the consciousness not only of people in the executive branch, but people on the joint committee. And I think it is fair to say that on the physical security front for commercial handling of plutonium and highly enriched uranium, there was virtually no change for 25 years, but there have been changes for a couple of years now.

So, a new round of regulations has been made, but I think they still fall short of what we need. We have little time to bring this problem under control.

Chairman HUMPHREY. Particularly if you go into the breeder reactor program, because then your plutonium problem becomes exacerbated. It becomes more extensive and intensive. This is what bothers me. There is a good deal of publicity about what ERDA and the NRC have been doing to deal with these problems of safeguards and, quite honestly, much of what we see seems to be on paper only, in studies and designs and paper proposals.

But now the GAO has done some investigation of the safeguards problems, even after some of these paper designs for better security had been outlined and after the AEC had assured the Congress that safeguard plans were adequate. The GAO found incredible laxness on the part of industry, both in the transportation of highly enriched uranium and plutonium and in the production plants and storage facilities. I understand you also found such problems?

Mr. TAYLOR. Yes; that is correct, Senator.

Chairman HUMPHREY. So how do we make the jump from the paper that comes up here—you know, a statement from AEC or ERDA—to effective execution of policy?

Mr. TAYLOR. Well, I think the key jump is a revision of the regulations. Before the regulations are revised, however, I think it is extremely important to do what the Regulatory Commission is, in fact, now doing; that is, to make an intensive examination of the whole question of what are the alternative ways of making plutonium and highly enriched uranium more secure and what are the safeguards, the advantages, and the costs.

So, rather than coming out with a new patchwork set of regulations, I think it would be better if they really complete the thorough attempt to study this problem. I must say that attempt is now really underway. They have only been underway for about 2 months in the Regulatory Commission.

Chairman HUMPHREY. Do you think we are spending enough, both time-wise and money, on this issue?

Mr. TAYLOR. In the studies, I think just about. At some point, one saturates one's ability to find people who are knowledgeable in this area. They study that the NRC now has underway is many times what it was a year ago, and I think that is a very healthy sign. You might say it is a lot of talk and paper work and we still have inadequate security, and that is true; but I think there are strong indications from the new Commission that the results of this work will be implemented quickly and effectively. There are signs that industry is beginning to take this problem very seriously, too.

Chairman HUMPHREY. A number of the handlers of these radioactive materials in the transportation system are literally rebelling about handling it. The mayor of the city of St. Paul has been down to see me and has talked to me extensively about this. He is very upset over information that has come to him through railroad workers and others in handling radioactive materials. That is one of the safeguard problems and one of the health problems associated with it.

When I was in Vienna, I went to the International Atomic Energy Agency and spent considerable time going over their efforts to monitor the plutonium generated by nuclear reactor plants, and they are attempting now, as you know, to strengthen their international safeguards. We still don't believe those safeguards are sufficiently effective, but——

Mr. TAYLOR. Yes, one comment on the international situation. The IAEA safeguards are designed to detect diversion by national government. They are excluded by general agreement from implementing any physical security safeguards——

Chairman HUMPHREY. Yes.

Mr. TAYLOR. However, it is becoming clear that quite a few countries are realizing that it is in their own best interest to see to it that material within their borders is very much more efficiently protected from theft than it has been, for the simple reason that terrorists or criminals may steal it from them and come back at them with nuclear explosives. And I must say that there is a vested interest in all countries, whether they sign the nonproliferation treaty or not, in seeing to it that this material is well guarded. That fact is my primary basis for feeling somewhat hopeful that this problem can be solved internationally. If it weren't for that vested interest, I would say we are just going to have to live with nuclear violence at least off and on.

Chairman HUMPHREY. I sensed that when I was in Vienna talking with the International Agency people there. Just as you said, more and more representatives of national governments are taking a whole new look at this matter because of the concern they have over terriorist groups and the possibility of nuclear violence on a limited basis, if anything could be limited that is called nuclear.

I want to thank you very much for your part of this testimony. Let me say we on the Joint Economic Committee obviously are not responsible for safeguards. We are primarily responsible for cost-benefit questions and cost overruns and the economics of the breeder reactor versus other energy sources. But there is a cost factor also in the safeguards. If you place sufficient safeguards into the plants, that has its effect on the cost of breeder reactors. It adds to that cost. Is that not true?

Mr. TAYLOR. That is correct. I will say this. I think the cost of adequate safeguards is going to be a lot less than the cost to the society of inadequate safeguards.

Chairman HUMPHREY. Yes, very important. I want to thank you very much, Mr. Taylor. Let me again, for the record, announce that on Thursday, May 8, at 9:30 a.m., in room 318 of the Russell Senate Office Building, we will have a panel consisting of Mr. Robert Seamans, Jr., Administrator, Energy Research and Development Agency; Mr. Ralph Nader, Public Citizen Groups; John Simpson, director, Westinghouse Electric Corp.; and Thomas Cochran, Natural Resources Defense Council; and finally, Thomas Stauffer, from Harvard University.

Thank you, and the meeting is recessed.

[Whereupon, at 1 p.m., the committee recessed, to reconvene at 9:30 a.m., Thursday, March 8, 1975.]

FAST BREEDER REACTOR PROGRAM

THURSDAY, MAY 8, 1975

CONGRESS OF THE UNITED STATES,
JOINT ECONOMIC COMMITTEE,
Washington, D.C.

The committee met, pursuant to recess, at 9:30 a.m., in room 318, Russell Senate Office Building, Hon. Hubert H. Humphrey (chairman of the committee) presiding.

Present: Senator Humphrey; and Representatives Bolling and Long.

Also present: William A. Cox, George R. Tyler, Larry Yuspeh, and Robert D. Hamrin, professional staff members; Michael J. Runde, administrative assistant; and George D. Krumbhaar, Jr., minority counsel.

OPENING STATEMENT OF REPRESENTATIVE BOLLING

Representative BOLLING [presiding]. The committee will be in order. deal of attention has been directed to breeder reactors.

We have a very full schedule this morning, and I am a pinch-hitter.

A few days ago the chairman of the Joint Economic Committee, Senator Humphrey, called me and in a brief conversation indicated that his schedule had been drastically changed and that he would not be able to be here to open these hearings.

I have a general familiarity with the nature of the problem, have followed some aspects of it for quite a long time and am generally aware that, far from being a technical, simple matter, it is an enormously complicated matter that involves, in a sort of a mild and complicated way, liquid metal fast breeder reactors.

The subject matter involves not only a fundamental difference in philosophy as to what kind of economy the United States should have, an argument between those who put their emphasis on economic growth and full employment, and those who are more concerned about environmental aspects and other matters.

It also involves fundamental differences in assessment of the future, in terms not only of the needs of the United States for energy, and in particular various kinds of energy, and the costs that those different kinds of energy will bear at different times in the future, it involves a different assessment of the value of various kinds of energy development, of whether we should go a nuclear route, or nuclear and many other things route; what kind of research and development we should support, how much of it should be supported by the Government, how much should be supported by private entities that will in one fashion or another be responsible for the production of power, and yet, at the same time, will profit from the production of that power.

In other words, a whole complex which relates to every different aspect of the future of the economy of the United States, and quite naturally, in these times, the conflict is perceived in utterly different ways by different individuals.

Now, the Joint Economic Committee has had one hearing on this subject, this complicated and difficult subject on the liquid metal fast breeder reactor and all of its component parts, planned and perceived. In that hearing the Comptroller General of the United States and another witness were essentially very critical of what had happened to date, raised questions about some of the positions taken with regard to the demand for electricity, the cost for electricity, the viability of this particular technique—of this particular process, and in general raised the fundamental questions as to whether the cost could be justified, whether the cost factors were under control, and raised most of the questions that I guess this committee and Congress will be concerned with.

Now, our first witness is a man who is under great pressure, particularly today. He has a 12 o'clock deadline on an entirely different subject of substance, but on the other hand, he is the only person, really, who can answer some of the questions that the committee would like to ask. So, in order to accommodate him and us, I am going to suggest, Mr. Seamans, that after you make your presentation, and I have an opportunity and others who wish to question you relatively briefly, that you will agree to answer in writing for me, at an appropriate time, a series of questions, some of which may be as difficult or more difficult than the ones I ask.

Having had a conversation with you, I am aware of your own view of the kind of situation you are in. I am aware of the fact that others would very much like to get you to answer some questions that are very difficult and perhaps impinge on your view of what you are supposed to be doing in your statutory position.

So with that introduction, I would like you to proceed as briefly as you wish. Your statement and all other statements will be put in the record in full, and perhaps we will have an opportunity to ask a few questions to the limit of your time. I recognize your commitments.

Mr. Seamans.

STATEMENT OF HON. ROBERT C. SEAMANS JR., ADMINISTRATOR, ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION, ACCOMPANIED BY GEORGE W. CUNNINGHAM, DEPUTY DIRECTOR FOR DEVELOPMENT AND TECHNOLOGY; MERRILL J. WHITMAN, ASSISTANT DIRECTOR FOR ENERGY SYSTEMS ANALYSIS; MELVIN A. ROSEN, ASSISTANT DIRECTOR FOR PROGRAMS; LLOYD W. SIDES, GENERAL COUNSEL'S OFFICE; ROBERT D. NININGER, ASSISTANT DIRECTOR FOR RAW MATERIALS, PMM; ABRAHAM S. FRIEDMAN, DIRECTOR, DIVISION OF INTERNATIONAL PROGRAMS; AND H. HOLLISTER CANTUS, DIRECTOR OF CONGRESSIONAL RELATIONS

Mr. SEAMANS. Mr. Chairman and members of the committee, I welcome this opportunity to discuss with you today the liquid metal fast breeder (LMFBR) development program and the current role of the Energy Research and Development Administration (ERDA) in that program. Accompanying me is Robert D. Thorne, Acting Deputy Assistant Administrator for Nuclear Energy, who also has a statement about the program.

ERDA's principal mission is to develop realistic energy options for the Nation's future. At the present time ERDA is in the midst of preparing a rigorous analysis of national energy needs and options to meet those needs. I might say we have been going over our plan just this past week with all of our principals involved, and one of the big issues we face is our own domestic supply of oil and gas. In the past there have been some differences of viewpoint on this as to whether our domestic supplies will be depleted. I notice that the U.S. Geological Survey has just come out today indicating that the reserves are probably half of what they anticipated. This brings them more in conformance with the view of others and indicates that we have probably no more than 20 or 30 years of oil and gas remaining in this country.

This analysis is required by the Nonnuclear Energy Research and Development Act of 1974 to be submitted to the Congress by the end of next month. I hope that this analysis will serve to provide a basis for the wise choice and development of energy options which are both environmentally and economically sound. Among the options presently under consideration is nuclear fission. Within that option a great deal of attention has been directed to breeder reactors.

ERDA assumed the research and development functions of the Atomic Commission (AEC) and several other energy agencies on January of this year. One of the programs which ERDA inherited from the AEC was the LMFBR program. AEC had been engaged for several decades in the development of nuclear power reactors to help meet the Nation's need for energy. Several reactor concepts have been successfully developed and have come into commercial use. They are now producing about 8 percent of the Nation's electricity from the energy released from the fission of uranium. Because of limitations inherent in these systems, however, only 1 to 2 percent of the energy potentially available in uranium can be utilized. Thus, the long-term advantages of generating electricity from nuclear fission may be severely constrained unless large additional quantities of natural uranium are found in nature, or unless substantial improvements can be achieved in the efficiency of uranium use. The breeder concept has been the subject of worldwide interest for almost two decades because of its potential for highly efficient uranium utilization. It has been estimated that commercialization of a breeder reactor technology could lead to the utilization of more than 60 percent of the total energy from uranium.

Accordingly, the research and development program initiated in the 1950's was substantially expanded in the late 1960's by the AEC to develop an environmentally acceptable breeder-reactor technology option which would be capable of meeting a substantial portion of this Nation's electric power requirements. AEC selected the sodium-cooled LMFBR as its highest priority breeder reactor development program because of its predicted performance, proven basic technological feasibility, existing industrial support, and established base of technological experience. The LMFBR program—development and demonstration of a broad technological and engineering base with extensive utility and industry involvement—is being carried out by national laboratories and by industrial firms at a number of locations throughout the country. Currently, the two principal elements of the LMFBR program are the Clinch River Breeder Reactor (CRBR) project and the base technology program, including the construction and operation of test facilities such as the fast flux test facility.

Congress authorized the AEC to conduct the project definition phase of an LMFBR demonstration program in cooperation with industry on July 11, 1969, almost 6 months prior to the time when the National Environmental Policy Act (NEPA) went into effect. Thus, by the time the NEPA became applicable on January 1. 1970, the LMFBR program had progressed through the initial research and development phase-demonstration of the feasibility of the breeder reactor concept and confirmation of the basic technical aspects. It was already well into the second-phase development of engineering understanding.

Subsequently, Congress expanded this limited authority into a fully authorized, complete demonstration project. On June 2, 1970, the AEC was authorized to enter into a cooperative arrangement with industry for the development, design, construction, and operation of an LMFBR powerplant, the CRBR.

In April 1972 the AEC issued an environmental statement assessing the environmental impacts which would be associated with the construction and operation at an undetermined site of a 300- to 500-megawatt electrical, sodium-cooled, LMFBR powerplant. In June 1973, in conformance with a U.S. court of appeals decision, AEC embarked upon the preparation of a broader environmental statement. This statement was to address the reasonably foreseeable environmental, social, technological, and economic costs and benefits of a prospective mature LMFBR economy and of its possible technological alternatives.

After considering suggestions from interested organizations and the public as to the scope and content of that statement, the AEC issued the statement in draft form in March 1974 for outside review and comment. A public hearing on the LMFBR program in general and the draft statement in particular, was held on April 25–26, 1974. The AEC then prepared a final environmental statement, which normally would have concluded the NEPA review process. However, ERDA was about to be born, and the AEC was reluctant to foreclose the options of the new agency in shaping its own research and development program. Hence, the AEC released the document as a "proposed final environmental statement," and recommended that ERDA consider the statement itself, provide ample opportunity for further public comment, and hold another public hearing on the statement and the LMFBR program.

We accepted these recommendations. Full and fair review will be a substantial undertaking. The proposed final environmental statement is some 4,300 pages long, consists of 7 volumes, and stands well over 1 foot high. I have requested a team of four senior ERDA officials not previously involved in the preparation or review of the proposed final environmental statement to assist me in this review. They are: The Deputy Administrator, Mr. Robert W. Fri; Assistant Administrator for Solar, Geothermal, and Advanced Energy Systems, Mr. John M. Teem; Deputy Assistant Administrator for Fossil Energy, Mr. S. William Gouse; and Deputy Assistant Administrator for Conservation, Mr. James S. Kane.

Their purpose is to undertake an objective and comprehensive review of both the proposed final environmental statement and the public comments received. They have the specific objectives of (1) determining whether issues relevant to a decision on the LMFBR program are adequately treated in the statement, and (2) making suggestions for insuring that the record is adequate for decisionmaking.

I have enjoined them to consider carefully whether the options contained in the proposed final environmental statement have been adequately evaluated, and particularly whether all relevant options have been considered. As a part of this review they will conduct a public hearing in Washington, D.C., starting on May 27. ERDA staff comments on the principal issues raised by Government agencies and public commentators will be issued before the hearing in order to focus the critical concerns for fruitful discussion at the hearing. In addition, I have requested a group of knowledgeable scientific and technical individuals outside ERDA to provide me with the benefit of their views on certain aspects of the program. They are: Director of Environmental Assessments Cyril S. Comar, Electric Power Research Institute; Donald B. Rice, president, Rand Corp.; Eugene P. Wigner, formerly professor of theoretical physics, Princeton University; Walter H. Zinn, formerly vice president, Combustion Engineering; and Alvin Weinberg, formerly Director of the Office of Energy, Research and Development, Federal Energy Agency.

The apparent potential of the LMFBR for lowering the cost of electric power over the long run and for providing an ever-renewable domestic source of fuel for producing energy makes it seem like an important option. Nevertheless, there are many other aspects of that option which must be given the most careful further consideration. For example, I am concerned, as I know this committee is, with the increases in program cost which have been reported. Mr. Thorne is prepared to discuss these in some detail. As another example, I am concerned with ascertaining what higher costs we may incur by not pursuing the current schedule, and conversely what benefits we may obtain by selecting other needs and options for greater emphasis in the near term.

I do not have answers to these questions—and many others—at this time. Review of the proposed final environmental statement is one way I hope to obtain those answers. Another way is the systematic comparison of energy options which is an essential part of creating the energy research and development plan which I mentioned at the beginning of my statement and which is the major task occupying ERDA right now. Here, among other things, we are looking at the interrelationships between all elements of the LMFBR program, cost estimates, and the relative returns from various other R. & D. investments.

These two efforts, the LMFBR environmental statement review and the program comparisons which are a part of the overall energy research and development plan, go together in many ways. We must complete them before I can make my own judgments and recommendations on the future of the LMFBR program.

It was with full knowledge that this review process was not yet complete that the administration requested revisions to the original authorization for the CRBR project. This fiscal year 1976 legislative request relates only to funding and management policy and in no way alters the environmental significance of the CRBR project. The legislative request was made in order to maintain the viability of the LMFBR program as planned during these important deliberations, but with recognition that changes could be made to reflect the conclusions of our analysis of energy options in the energy R. & D. plan and of our consideration of the environmental statement. Indeed, approval of this legislative request by the Congress will not, under the circumstances, constitute an irreversible commitment to proceed. ERDA has made no such commitment, and I repeat, I personally will make no decisions without the benefit of the complete reviews I have mentioned.

I have, however, given my personal attention to the management of the CRBR project. It was apparent to me that the responsibility for the project management was unnecessarily diffused and the management structure was unduly complex and cumbersome.

We have taken steps to restructure and streamline the project management into a single-line organization, staffed on an integrated basis with both government and utility industry personnel. At the same time, because of the large increase in the estimated cost of government participation, ERDA will assume full responsibility for overall management of the project. The principles upon which this assumption of management responsibility and restructuring will be based have been agreed to by the utility companies participating in the project and submitted to the Congress as part of the fiscal year 1976 legislative request. The new structure will enable ERDA to utilize fully the expertise of personnel from the public utility industry in specific areas and at the same time provide on-the-job training for future procurement and operation by the utilities. With these management changes, ERDA should be able to marshall all project resources in a more efficient manner and thereby attain approved project objectives on time and within currently estimated costs.

In conclusion, Mr. Chairman, when we look at the energy picture in total perspective, with all the tremendous energy needs of this country in the future, we simply cannot afford to discount any particular option arbitrarily. The nuclear option, and specifically the LMFBR, appears at this point to have several promising features, and there are strong advocates for it both within ERDA and the scientific community. I have also heard from those who have strongly held beliefs against the development of breeder technology, and I know this committee has heard and will continue to hear from these people as well. This is as it should be. But by the same token, I believe that this committee should have the same opportunity that I have to hear the views of those within ERDA who advocate the LMFBR program. Accordingly, I have asked the Acting Deputy Assistant Administrator for Nuclear Energy, Mr. Robert Thorne, to present to you these views. At the conclusion of Mr. Thorne's statement, he and I will be happy to address any specific questions the committee may have.

I will leave it to your judgment, Mr. Chairman, whether you would like to have him present his views or submit his statement for the record.

Representative BOLLING. We thank you, Mr. Seamans. I think in order to be able to accommodate you and to accomplish some of the things we would like to accomplish, I would like to postpone Mr.

Thorne until I have asked a few questions of you, and then we will have Mr. Thorne proceed with a summary of his statement. After we have asked you the questions, you can go along to your other problems.

Now, the questions are going to be raw and bloody. I know of no way of politely expressing the kind I am going to ask. They are those suspicions raised with me by others. Your answers are what I would be interested in, not the suspicions.

The question in essence is, you have indicated clearly that you have a statutory responsibility to make a judgment between alternatives. My question goes to the question of whether you haven't really already made that judgment. I remind you that these are questions that come from certain statements that you have made earlier and that others have made, not in your behalf but about your position.

Now, the main dilemma stems from a letter that you sent on March 10, 1975, to Senator Pastore. I will read a brief comment at this point.

In your letter of March 10, 1975, to Senator Pastore you indicated, among other things, that the CRBR authorizing legislation of June of 1970, which I gather is still in effect, provided for Government assistance in value of less than $80 million. Then, in 1971 when it became clear that the utilities and reactor manufacturers were not interested in financing the balance of the CRBR project on an open ended basis, AEC requested Congress to authorize $100 million-plus indirect assistance of up to 50 percent of CRBR costs, subject to the provision that none of this be used for end capital items for the plant.

Was this authorization ever received? Did this revised authority pass Congress?

Mr. SEAMANS. I would ask Mr. Thorne to answer that question.

Mr. THORNE. Mr. Sides can answer that.

Mr. SIDES. I didn't hear the end of the question, can you repeat it, please?

Representative BOLLING. The question part of that statement was: "Was this authorization ever received when this authority passed Congress?"

In other words, there was a request for a revision in the CRBR authorization. What is the record on whether it ever became an act?

Mr. SIDES. The request for legislation, sir, that was submitted on March 10, 1975, was the subject of a hearing before the Joint Committee on Atomic Energy, and I understand a clean bill was filed in the Senate on the 6th of this month. Does that answer your question?

Representative BOLLING. We are talking about a 1971 authorization.

Mr. SIDES. The 1971 authorization?

Representative BOLLING. Yes.

Mr. SIDES. Yes, that was passed, Public Law 91–273.

Representative BOLLING. Your letter goes on to state that as negotiations with industry progressed, it emerged that AEC was to expressly assume the open ended risk of all project overruns and other financial risks, and industry was unwilling to pitch in any more than the amount previously attributed to them. Those were not exactly the words I would use if I had time to redo the statement because I have implications that go beyond my intent in terms of asking the question.

These private interests were to limit their exposure to $250 million. You state that these basic conditions were accepted and definitive contracts for the project were executed. However, neither the authorization nor the statutory criteria was changed to recognize these very basic significant changes in the groundrules on Government assistance.

In the meantime, the present cost estimates have increased radically and the Government's expected contribution has increased from something under $80 million to over $1.4 billion.

Is there any comment on that? The point is, under what authority did AEC agree to that? It is an open ended commitment? It seems to me this is a valid question. I am not trying to embarrass you. I am not clear as to whether you are able to answer that now, any of you, but I would like to know the answer to that.

Mr. SEAMANS. I would like to know the answer, too. I don't know the answer myself at this point.

Mr. SIDES. I would like to say, sir, that we would like to reserve that question and submit a complete answer in writing rather than give you one off the cuff.

Representative BOLLING. That suits me very well, but I want to be assured that I will get the answer and get it relatively promptly so I can complete the record.

[The following information was subsequently supplied for the record:]

The substance of Mr. Bolling's question as we understand it was whether the authorization request in 1971 for the Liquid Metal Fast Breeder Reactor (LMFBR) Demonstration Project was ever enacted into law, and also under what authority did AEC agree to assume an open-ended risk for project overruns.

Congress did authorize the cooperative arrangement for the LMFBR Demonstration Plant under section 106 of Public Law 91–273, as amended by Public Law 92–84. The basis of the original cooperative arrangement was approved by the Joint Committee on Atomic Energy (JCAE) after three days of public hearings held in September, 1972. The text of those hearing was published as a JCAE print and the considerations and recommendations of the Committee in approving the original arrangement are set out in the introduction of that document (LMFBR Demonstration Plant hearings before the JCAE, September 7, 8 and 12, 1972).

In January, 1973, the Atomic Energy Commission informed the JCAE that, in the process of negotiating the definitive contracts for the cooperative arrangement, the parties had agreed upon several changes in the basic principles previously submitted to that Committee, and, in accordance with section 106(b) of Public Law 91–273, as amended, revised program justification data setting forth the details of the negotiated proposed arrangement were submitted to the Committee along with the negotiated but unexecuted contracts. The revised program justification data thus submitted and the accompanying unexecuted contractual documents included a good faith undertaking on the part of the Atomic Energy Commission to seek additional legislative authorization and funds if at any time it should reasonably appear that resources available for the project were insufficient to permit the continued effective conduct of project activities. This is what has since been loosely characterized as an "open-ended" commitment.

During the course of extensive hearings on February 28 and May 4, 1973, the JCAE examined the merits of the proposed changes to the cooperative arrangement in great detail, including the good faith obligation of the Atomic Energy Commission to seek additional funding should the need arise. The JCAE was aided in this consideration by two reports from the Comptroller General as well as by testimony from members of the public, and additional material was furnished to the Committee by the Atomic Energy Commission to clarify aspects of the proposed arrangement in connection with which questions had been raised. The JCAE also met in executive sessions on May 23 and 24, and June 8, 1973 to further consider the proposed cooperative arrangement in depth and to determine whether or not it was acceptable.

The Committee ultimately decided that it would interpose no objection to Atomic Energy Commission execution of the proposed contracts as finally revised in several respects and clarified during the hearings because of Committee concerns, and specifically noted its agreement with the concept of AEC assuming an obligation to seek additional funds from the Congress if the need became apparent with the utility participants carefully limiting the extent of their contributions and risks to about $250,000,000. In so doing, the Committee also noted that the Atomic Energy Commission commitments to endeavor to obtain additional legislative authorization would provide a distinct point after considerable planning and design work had been accomplished, and prior to construction, which would afford the Congress an additional opportunity for a detailed review of the status of the project. The Committee stated its intention to review the situation in depth at that time and to provide the Congress with its findings and views in connection with any such requested legislation.

It is respectfully submitted that this is precisely the process which is going on right now. The Energy Research and Development Administration has submitted revised program justification data and other suggested revisions to its authorization legislation for this project to the Joint Committee, in accordance with the procedure established by the Congress when it originally enacted P.L. 91–273, as amended—a procedure which has been consistently followed by the Congress in authorizing cooperative Power Reactor Demonstration projects for almost 20 years. These revisions are currently undergoing review and consideration by the Congress in the normal legislative process.

It is our view that the contractual arrangements for the Clinch River Breeder Reactor Demonstration Project were fully authorized under P.L. 91–273 as amended by P.L. 92–84. As is clear from the record of the hearing, Congress also recognized that the estimated cost of the Project might very well increase as it developed. Accordingly, the assumption by the Atomic Energy Commission of the so called "open-ended" risk for this project, i.e., the obligation to seek additional authorization and funds if needed, was entered into in the full light of Congressional oversight and in full accord with the specific provisions of the enabling legislation.

Representative BOLLING. The dilemma here is obvious. There is also already an escalation of a degree of suspicion beyond what I think is reasonable in Government, and the only way we can get it cleared up is to get all the answers on the table and try to get the answers out to the public before the Congress takes the step that is imminent to make a further commitment to a program that has not yet been decided upon.

I don't want to be misunderstood on this. What I am interested in is not heat but light, and the only way I can see any possibility of getting some light is to ask these questions so that we can clear it up.

Mr. SEAMANS. My understanding was that we embarked on a program of approximately $700 million that would be coshared with the utilities and they would finance about $250 million of that amount. This was fully understood, I believe, by the Congress who thoroughly reviewed it with the Joint Committee on Atomic Energy; I assume all the enabling legislation has been passed.

The estimate of the cost of the Clinch River breeder reactor did increase to $1.7 billion. It is my understanding that these increases had been discussed by the AEC with the Joint Committee on Atomic Energy prior to the formation of ERDA. I knew there had been concern about the management arrangements with a tripartite type situation that had been made in the past. I was against such an organization myself, I think the Government is putting up a sizable amount and must take the primary responsibility, certainly when it is well over 50 percent. I thought I was doing the most appropriate job when

I met with the utilities and negotiated with them what I think was a clearly superior method of management, and I didn't think I was doing anything that was not completely within our enabling legislation.

Representative BOLLING. I think that is the key question. You may know I have been something of a critic of the way Congress organizes itself and functions. So I am not clear where the responsibility lies, if we do have, for all practical purposes, an open-ended set of commitments that stem from a process that isn't very precise. I am not inclined to automatically blame an administrator for that kind of a situation. But you are also aware that there have been criticisms in the past from a variety of sources of the relationship between the Joint Committee on Atomic Energy and the Atomic Energy Commission. They are not criticisms that I have joined in voicing, but the key question here seems to be whether or not the process actually resulted in a legal act by the Congress or whether it was a continuation of a process which has become the custom of the Atomic Energy Committee, in effect, functioning in behalf of the Congress.

Now, I am aware of all the dilemmas implicit in that relatively simple statement, but I think, since the matter has been raised, not entirely by me alone, that it is something that we should get cleared up and we will try to structure some questions that do not carry with them a load and that you will be able to answer precisely in a reasonable time. I would hope that you would not take too long in trying to get a reply back.

I have one other question; does my colleague have questions?

Representative LONG. I do. The reason I was trying to ask you to yield, Mr. Chairman, even though you went ahead and covered the specific question, is what specific piece of legislation would give you, Mr. Seamans, the authority to enter into what appears to me to be an open ended contract, and where in that piece of legislation is the specific authority to enter into such an open ended contract?

Representative Bolling, in effect, here covered that in his subsequent questions.

Do you want me to proceed with a couple of others?

Representative BOLLING. Yes.

Representative LONG. One of the stories in the Wall Street Journal a couple of weeks ago, I think it was, Mr. Seamans, was with respect to the exportation of uranium to Russia for processing. They indicated in this article that this uranium, which was being exported, was really going to be sold to European utilities. Was this article basically correct? Are we exporting uranium to Russia for processing and then for sale to European utilities?

Mr. SEAMANS. The whole matter of the sale of uranium and the sale of enriched uranium is a very complex matter.

We do, ourselves, sell enriched uranium. It is used to provide the fuel for reactors that we sell to foreign utilities. It is done under the overall cognizance of the International Atomic Energy Agency. The spent fuel is returned to the United States for processing.

In the last year or so we have not been able to take any orders for enriching uranium because we have now reached the capacity of our own plants. For that reason I believe that in some cases we have established arrangements such as the one you described.

I would like to provide the details of that transaction, for the record, if I might.

Representative LONG. Fine.

[The following information was subsequently supplied for the record:]

The export of U.S. origin natural uranium is authorized under the provisions of appropriate Agreements for Cooperation in the Civil Uses of Atomic Energy in an attempt to stimulate domestic exploration and resource development by increasing the potential market available to domestic producers. Since the enriching capacity of the three Government gaseous diffusion plants is presently fully committed, ERDA has permitted, under specific authorization, the export of natural uranium for enrichment in foreign facilities, including those of the U.S.S.R., for subsequent use in reactors in countries with which the U.S. has an Agreement for Cooperation.

In the case of the Edlow International Company shipment, the export license provided for the shipment of uranium oxide from the United States to the U.K. for conversion to hexafluoride (UF_6), enrichment of the UF_6 in the U.S.S.R., and fabrication of reactor fuel by Brennelemente GmbH in West Germany for use in West German reactors. Upon completion of the enrichment service in the U.S.S.R., both the slightly enriched uranium product and the depleted uranium ("tails") resulting from the enrichment will be shipped to the Federal Republic of Germany. The product and tails exported from the U.S.S.R. will together equal the amount of uranium which was imported from the United Kingdom. The spent fuel remains in the Federal Republic of Germany; it is not returned to the U.S. for reprocessing.

With regard to the Transnuclear shipment that was mentioned in the article, although the export licenses were issued by the NRC on August 1, 1974, to export 357,856 lbs. of U.S. origin natural uranium to Liverpool, England for conversion to UF_6, approval has not yet been granted to export the material to the U.S.S.R. for enriching. The ultimate consignee of the enriched uranium, Agip, Milano, Italy, will use the enriched uranium in the manufacture of nuclear reactor fuel assemblies for Italian nuclear power plants. The material is presently at British Nuclear Fuels, Ltd., in Liverpool.

Representative LONG. Could I then ask a couple of questions? Again, you might not be able or willing to answer them right now. The major rationale all the way through for the breeder reactor program is that we are rapidly depleting our uranium reserves and AEC must develop some type of commercial breeders before we do deplete these reserves. If we are selling it abroad, we are, depleting these reserves, and could they not be held as reserves without selling them for use abroad?

Then, specifically, also, we would like to know how much uranium of the total mined domestically is destined for export either directly or by other nonmining companies, if that is ascertainable. How much of the world's reactor fuel do we supply? Do we have any long-term commitments in this regard at all to sell uranium abroad? Have we made any commitments that perhaps have not been given a great deal of publicity with respect to the sale of uranium long range in the other parts of the world?

That is all I have at this time, Mr. Chairman.

Mr. SEAMANS. If my understanding of the question that you asked with regard to the sale of uranium overseas is correct the answer is, yes, there has been a sale of uranium overseas by some of our utilities. This has been on the basis of their need to procure the uranium that then goes into our processing plants and, in some cases, they have delayed going ahead with the construction of their plant for a variety of reasons. They have been short of cash and they have sold overseas—the uranium which they own.

Now, this is a matter that concerns me for the very reasons that you bring up the question.

Representative LONG. Would you repeat that? As I understood what you said, they had the uranium on hand, and they were delayed in the need for it themselves, and because of a cash shortage on their part they have sold some of this abroad; is that correct?

Mr. SEAMANS. That's correct. They own it, remember that. We don't own the uranium, it comes to us when we enrich it, and we charge the utilities for the processing into the fuel that is used in the reactor. But we don't own that uranium.

Representative LONG. But I understood, my recollection might not be correct, if I remember, the article correctly, it was speaking of raw uranium being sold in this regard. So we are not really speaking of the same thing at this point; are we?

Mr. SEAMANS. I would like to have Mr. Thorne answer that question.

Mr. THORNE. Mr. Long, very little raw uranium mined in this country has been sold overseas. Quite a substantial amount of uranium mined overseas has been brought into this country by foreign reactor utilities. They have now gone into the enriching process and that uranium has been returned back overseas. But very little domestic uranium ore has been sold overseas.

Representative LONG. So what the Wall Street Journal, in effect, was doing was making a mountain out of a molehill with respect to these sales of raw uranium?

Mr. THORNE. Yes, sir, and we will be glad to provide for the record those sales over the years.

Representative LONG. Thank you.

[The following tables were subsequently supplied for the record:]

TABLE I.—*Foreign uranium commitments by domestic producers as of Jan. 1, 1975*

Year of delivery:	*Tons* U_3O_8
1966 through 1973	5.500
1974	1,500
1975	600
1976	500
1977	1,400
1978 and 1979	1,100
Total	10,600

NOTE.—As of Jan. 1, 1974, total was 6,900 tons, 3,700 were committed to foreign buyers in 1974.

TABLE II.—URANIUM DELIVERY COMMITMENTS, DOMESTIC PRODUCERS TO DOMESTIC BUYERS, AS OF JAN. 1, 1975

[Tons of U_3O_8]

Year of U_3O_8 delivery	Annual	Cumulative
1966–73		55,600
1974	11,900	67,500
1975	15,600	83,100
1976	12,600	95,000
1977	12,700	108,400
1978	15,300	123,700
1979	13,900	137,600
1980	11,600	149,200
1981	10,400	159,600
1982	8,800	168,400
1983	7,100	175,500
1984	4,500	180,000
1985	4,100	184,100
1986	1,900	186,000
1987	1,400	187,400
1988–94	(1)	191,300

1 Less than 1,200 per year.

TABLE III.—URANIUM DELIVERY COMMITMENTS, IMPORTS BY DOMESTIC BUYERS, AS OF JAN. 1, 1975

[Tons of U_3O_8]

Year of U_3O_8 delivery	Annual	Cumulative
1975	800	800
1976	1,500	2,300
1977	2,600	4,900
1978	3,100	8,000
1979	3,000	11,000
1980	2,700	13,700
1981	3,500	17,200
1982	3,700	20,900
1983	3,600	24,500
1984	3,600	28,100
1985	3,400	31,500
1986	2,300	33,800
1987–90	(1)	41,000

1 Less than 2,000 per year.

Representative LONG. Going back to the question I was discussing with you, Mr. Seamans, that is the sale by the private utilities companies of enriched uranium abroad, as I understood it, you expressed dissatisfaction with the fact that they had done this?

Mr. SEAMANS. No, I think we have a bad situation in this country when it turns out to be in anybody's interest to sell, for economic reasons, the uranium products overseas, except insofar as they fulfiill a commitment on a government-to-government basis coupled with the sale of reactors overseas. It seems to me that that is a plan that has been carefully worked out and that is in our interest. But to just have a random sale of the fuel overseas is not in our interest.

I think we should be conserving the uranium and the potential uranium fuel in this country because of the fact that we will at some point deplete our resources.

Representative LONG. That is obviously the reason that I raised this whole series of questions that I did ask.

It is your opinion that additional legislation is needed in this regard to preclude such a thing from happening again?

Mr. SEAMANS. No, I don't think that is necessary, this is a matter that we have very much under review at this time and it definitely relates to the need for increased uranium facilities here and the freeing up of and the definitization of the plant in this country for proper support of the present generation of nuclear plants.

Representative LONG. Is this exporting of either that which has been enriched or that raw uranium that we are speaking of combined? You indicated from the standpoint of the raw uranium discussed in the Wall Street Journal article, that it was not a substantial amount. On the other hand is the enriched a substantial amount, a sufficient quantity to be really a disturbing sort of situation, and is there any way of measuring that either percentagewise, dollarwise, or however you would measure it, atomwise, if that is the way?

Mr. SEAMANS. I don't have that at our finger tips, the number of nuclear plants that have been sold overseas, but it is a fairly substantial amount. I will put in the record the exact number, but to me this is an important part of our U.S. policy, that we will supply this type of equipment, the reactors and the fuel that goes with it, and I think it would be an unfortunate policy if we drew back from what is a very important item when it comes to balance of trade.

[The following information was subsequently supplied for the record:]

Through 1974 General Electric and Westinghouse accumulated orders abroad for 26 units each, totalling approximately 16,000 MWe and 18,000 MWe, respectively.

Mr. THORNE. I might add, Mr. Chairman, that the Atomic Energy Act requires that the enriching services provided by this country be done on a nondiscriminatory basis in relationship to foreign countries, and to the free world. We supply enriching services to foreign users on the same basis as we do to domestic customers.

Representative LONG. Is there any indication from the European countries that this exportation is of sufficient degree that it is imperiling your own program, and are you aware of any representations made to this Government by foreign governments?

Mr. SEAMANS. The only thrusts that I have felt since I have been on the job is a great desire of many foreign countries to work with us to help build up their capability. Japan obviously being one, where they must build up their nuclear capabilities because they have no fossil fuels of their own, and the cost of fossil fuels have obviously skyrocketed. They are putting in place nuclear facilities and they are very anxious to work with us. However, if we are not interested, they will undoubtedly work with other countries. I believe it is in our best interest to help them in this endeavor.

Representative LONG. In that regard, is the sale of reactors abroad made on the basis of the fact that there will be a guarantee of the uranium supply that is required in order to fuel that reactor?

Mr. SEAMANS. I don't believe it is essential, however, there is no point in having the reactor system unless you have the fuel for it, so normally the two go together, but I will be glad to supply more on that for the record.

Representative LONG. So, really, then, with respect to the selling of the reactors abroad, we are taking on a long-range dilution of supply problems that could become most substantial?

Mr. THORNE. Mr. Long, in the sale of reactors overseas, there is no understanding in the contract that the Government will assure the supply of that fuel because a good portion of the fuel is supplied by enriching services from other countries.

For instance, the Russians are supplying enriching services, and the United Kingdom and the French are taking orders for enriching services. However, this country offers it at a price much less than that offered by foreign countries, so most of the slightly enriched fuel does come from this country.

Representative LONG. But depending on Russia for it does nothing but intensify my interest in the question I asked earlier, because of the sale with respect to the Wall Street Journal article is again a dilution of reserves of the United States; is it not?

Mr. THORNE. It is not.

Representative LONG. Thank you, Mr. Chairman.

[The following information was subsequently supplied for the record in the context of the above interrogation:]

Power reactor sales from the United States are solely in the commercial sector. In order to export them, of course, it is necessary that there be a government-to-government arrangements (Agreement for Cooperation) providing for peaceful uses guarantees, and safeguards, and many other things. The fuel for the light water reactors exported from the U.S. (or by others) is enriched uranium and the enriching is done on a fee or toll basis, with the customer supplying the uranium to be enriched. This uranium is normally purchased abroad and imported into the U.S. for enriching (and sometimes fabrication) and then re-exported. The enriching for most foreign nuclear power plants is done in the U.S. by ERDA. It is not U.S. policy to tie the provision of enriching services to the sale of power plant equipment. In fact, most light water reactors sold by non-U.S. reactor manufacturers to date also depend on ERDA for the enrichment of the uranium for their fuel supply. In such cases, also, an Agreement for Cooperation must exist between the U.S. and the country in which the customer operates the power plant. In summary, the U.S. does not guarantee the supply of uranium for fuel nor does it condition the supply of enriching services upon purchase of a U.S.-supplied reactor.

A prudent customer will, of course, assure a supply of uranium and enriching services with uranium suppliers and enrichers, prior to proceeding with the construction of a nuclear power plant. Although the U.S. supplies essentially all enriching for power plant fuels at the present time, and will supply the vast majority of such enriching through this decade, there are other sources from which commercial enriching may be obtained thereafter, i.e., Eurodif and Urenco in Europe and the Soviet Union.

Representative BOLLING. Mr. Seamans, I have one more brief series of questions, and then I will suggest that you proceed to your other duties.

The question that keeps recurring as I talk to staff, and they produced some evidence to make the question valid, is how you can be an objective judge on a matter in which you seem to have a commitment, and some of the things that they brought to my attention that concern them and me, are in the testimony of Mr. Thorne before the Joint Committee on Atomic Energy on March 11, 1975. There are a series of questions, I would like to read them all, they are not that long, so it is not a loaded question or a trap question:

Mr. THORNE. To maintain the viability of the nuclear option into the next century, the highest priority in our fission power reactor development activities has been placed on the development of the liquid metal fast breeder reactor (LMFBR) with $350.6 million in fiscal year 1976 operating costs to be applied to that program. This includes $261.3 million for the base program, $35.4 million for the demonstration plant, $40.4 million for LMFBR safety, $13.5 million for advanced fuel technology.

Representative BOLLING. Now, I admit that that seems to be a fairly clear statement but I would like you to clarify your position as you see it, as the last answer that I ask of you, your position as you see it as a judge of an overall program, which has many component parts, and in particular this particular component?

Mr. SEAMANS. I will be happy to, Mr. Chairman.

As we look ahead to the period from 1985 to the year 2000, we can see that we are rapidly running out of fossil fuel. We are not quite sure when it will be depleted but somewhere in the period 2000 to 2010, we are going to have to have additional resources, completely new resources that are not available to us, as well as make use of everything that is available, such as coal, geothermal and so on.

During the period from 1985 to 2000, it appears to me that we must make increased use of coal to the maximum extent possible, and increased use of the present type of nuclear generating plant.

I believe if we do that, plus strong conservation measures and so on, we will give ourselves time to carefully review three possible alternatives for the long run when we are really out of fossil fuel, excepting coal.

One possibility is solar energy. We must look at that. Another possibility is the fusion process. We don't know if that is scientifically, much less technically and economically possible. We must look at that. The third possibility is the breeder program. It is the farthest along at this time. It, like the others, has potentially great benefits, but it also has risk.

I believe we must have, during the next 10- to 15-year period, strong programs in each of these three areas of the future. The solar, the fusion, and the breeder program.

Now, as to the specifics of what the breeder program should be, I am not exactly certain at this time. That is a matter that is now under review. But I am certain that there should be some form of research and development program. I am certain that we have to have it, not only to determine what the benefits may be and the costs may be but also to determine what the environmental effects really are on the basis of data, not on the basis of speculation. So I believe we must proceed with the development program.

Now, what that constitutes in terms of Clinch River and matters of this sort, I am not prepared to say today. These are the matters I am reviewing.

Representative BOLLING. Now, I would like to relate to the crux of the situation and that is that the committee has reported out a piece of legislation that deals in some fashion with this matter. That piece of legislation may come before the House, I gather, earlier than the Senate, but I am not sure of that.

Now, I would like to get your answer of the relationship of the responsibility of Congress on that authorization bill and the long run-short run problems that the Congress must share in deciding on it.

These, I think you have outlined very well in a relatively brief way. The dilemma that I see is this: Is there a direct relationship between this authorization bill and whether it should or shouldn't pass in the present form, and the questions we are trying to raise today.

Mr. SEAMANS. Well, I indicated in my previous comments that we are furthest along in the breeder program and it is obvious why. A great deal more effort has gone into it.

As a consequence ERDA inherited an ongoing set of projects with quite a number of contractors, as well as a very major internal effort. So the question before all of us is whether we want to turn everything off that has been started, then, if we decide to go ahead, attempt to start it all up again; or whether we should maintain the plan that we inherited long enough to decide whether to alter it, whether to cancel parts of it, or whether to go ahead.

The thrust of my letter to Senator Pastore on this matter was right on this point, whether we should attempt to turn everything off and then turn it on, or whether we should maintain the viability of the program until we review it and then decide what to do.

Representative BOLLING. Mr. Long.

DELAY IN BREEDER DEVELOPMENT

Representative LONG. I don't think anybody wants to cut the thing completely off. I think it is a question of how you can slow it down and reassess the situation and still maintain the viability of the entire program, which more correctly states the question, then closing it down and starting it up again.

This might not be something that you want to answer right now; maybe you would again like to give it in a written response. But, if you look at what the EPA critique of this whole question has been, they said the delay in the breeder introduction could be from 4 to about 11 or 12 years.

While this delay could pose great problems, it would give you and your organization an opportunity to discover, would it not, what uranium reserves perhaps did exist, to explore more fully the use of foreign technology, and to explore two things that are so technical that I hesitate to really discuss them because I am not that technically expert, and that is the use of new U^{235} enrichment techology and the development of solar energy. All of these relate to uranium reserves depletion.

Getting specific in that regard, could a delay in the construction of the Clinch River facility, of say, 4 or 5 years be accomplished without disturbing key personnel and the expertise you have developed there?

Mr. SEAMANS. You raise a number of important points, and let me first start with Mr. Train's statement of the EPA.

He did appear before the Joint Committee on Atomic Energy several days ago, and I would like to quote, if I might, from his statement:

> We indicate in our comments that using the latest energy demand projections of the Project Independence Report, our preliminary analysis is that a delay of 4 to 12 years might be accommodated without significantly reducing the uranium conservation value of the breeder. This should not be construed as indicating that the EPA is advocating a delay, but sufficient evidence exists to warrant an examination of the liquid metal fast breeder reactor timing assumptions.

He is talking about when you might want to have the breeder in use from an operational standpoint, and he was not addressing himself, although obviously the two are related somewhat, to when the development should be carried out.

Representative LONG. What I was doing, Mr. Seamans, was stating, that since he indicated there would be this timelag, could not this timelag be used to some advantage with respect to the analysis of the four or five problem areas that I just set forth, everything from the use of the lasers for U^{235} enrichment to the determination of what reserves we have, to an assessment of foreign technology and solar energy.

Mr. SEAMANS. You get down to the question of how we ought to make our decisions and how you carry out the analysis. I would submit that the way this has to be done is not to perform mathematical analysis, per se, but to build experimental stations, to test components, and to test various environmental and safety factors. If we think we may want to use solar energy or fusion or a breeder technology, we must put it together and see what the problems are as well as the benefits.

Now, with regard to the Clinch River, we don't actually have at this time any site construction underway and there is no intent to start the construction phase of Clinch River until we make our recommendations and until the Congress has a chance to review it and authorize ERDA to proceed. I want to make that clear at this time.

Representative LONG. I understood no construction had been started, but I also understood that you had developed over a period of time the expertise, and that there is a substantial funding level. My question was leading to this: What level of funding would be necessary to continue to maintain this expertise and maintain it without losing everything that has been done, even though we are not talking bricks and mortar at this stage of the game?

Mr. SEAMANS. I feel a tremendous responsibility for what happens to this country in the year 1985 and beyond. There is not always a lot we can do; but we can do something. We are facing a catastrophic situation in this country unless we can provide new sources of energy and be more efficient in the use of energy. This has to come from some place and I have named the three most significant alternatives for the long range. Therefore, since time is very short and it is going to get much worse, no matter what we do, and people are going to be short of electricity at home, and they are not going to like it, and their gas is going to get turned off and they are not going to like it, and people are going to lose their jobs in this country because there would not be energy resources in our factories, and the people won't like it.

My job is to get on with the development of these energy options, and I don't see any reason to just sit and wait. I think we must move ahead with development. So if there are good opportunities to get on with the development, then we should; but it ought to be done in a careful way with regard to the efficient use of resources, including making maximum use of our manpower and funds.

Representative LONG. Thank you, Mr. Chairman.

Representative BOLLING. Chairman Humphrey.

Chairman HUMPHREY [presiding]. I am sorry I wasn't here this morning with you for the opening of the proceedings but I had to be out of town last evening and even the miracles of modern transportation couldn't get me back here before this hour. I said I would be here at 10:30 and I am, and I appreciate your coming. I realize you are under some stress for time and we will accommodate your schedule.

I did not have the opportunity to hear your opening statement, you have undoubtedly read the record of our first hearing on the breeder reactor, the cost overruns that undoubtedly have been referred to here today, the very unusually large cost overruns and, of course, the question as to the timeliness of going ahead with these projects.

Now, the commercial introduction and use of the breeder reactors by utilities I understand is scheduled for 1987, a date that was picked assuming that electric demand will grow at historic rates. We have had testimony here a week ago as to whether or not the historic rate pattern would actually be followed in the use of electric energy in light of the higher electric costs. The oil embargo and the jump in electric rates, as I have indicated, has moderated the growth in electric demand. Utilities have recognized this and are canceling plant additions at record rates, over $30 billion in planned capacity additions have been canceled or delayed. That could be due to several factors, the high cost of money, the uncertainty as to what the future demand will be, there are many reasons for this.

As a result of these higher prices, it is now predicted by the GAO in its report, and subsequently underscored by the publication known as Electric World, by the Edison Electric Institute and by FEA itself, that electric demand will be 25 to 35 percent below expected levels in the future. That is well below the historic pattern.

The Environmental Protection Agency last week suggested that this moderated growth in electric demand means we can delay introducing the breeder reactor beyond 1987, even waiting until 1999.

Did ERDA or you, Mr. Seamans, ignore this new evidence, namely the belief that there would be a moderation in the growth of electric demand, did you ignore it in preparing the breeder's impact statement?

Mr. SEAMANS. The impact statement, which you see here, was prepared by the Atomic Energy Commission in previous years, as you know. Obviously, the latest information that you just referred to was not available to them at that time. That is one of the factors of which we are cognizant and which we are reviewing, not only with regard to the environmental impact statements but also with regard to the revision in our program plans which we will be presenting to the Congress on June 30.

I think it is a very valid point and I did, previous to your entering here this morning, mention that Mr. Train testifying on this issue obviously confirmed what you said, but he also stated that this should not be construed as indicating that EPA is necessarily advocating a delay in the present program. He indicated only that sufficient evidence exists to warrant reexamination. I agree with that.

Also, I said in response to a question from Mr. Long along these lines that we are faced with a severe situation in the long term, and I think that we had better get on with all reasonable developments right now so that we will have in hand, as the situation gets more and more acute, alternatives and options that the country can follow.

Chairman HUMPHREY. You did have much of this information alluded to by December 1; is that correct?

Mr. SEAMANS. It might be well, if you don't mind, for Mr. Thorne to respond to that.

Mr. THORNE. Mr. Chairman, the growth curves were used in the environmental impact statement, and the first version of that statement was developed almost 2 years ago. It was updated last fall.

Chairman HUMPHREY. And released in December?

Mr. THORNE. Yes. The growth curves that were assumed in that report are based upon a range called the high to low, based on AEC forecasts. The current data now available is very consistent with the low range in that statement.

Chairman HUMPHREY. Are you saying that the environmental impact statement was based on the low range of the electric demand?

Mr. THORNE. The statement contains a range of growth from high to low, and the median was the growth rate assumed for the environmental impact statement. Today's knowledge indicates that it should be the low range.

Chairman HUMPHREY. Are you going to revise the impact statement?

Mr. SEAMANS. Yes, we are. We are currently revising it. The methods we are using to review it and the actions we will take to revise it. I would like to reserve judgment on until we have gone through the process. But we will take into account in the final statement what we believe are the most likely things that will happen with regard to the electrical requirements in the future.

Chairman HUMPHREY. So it is apparent that you would likewise expect some reduction in demand of the historic pattern of electric energy, is that correct?

Mr. SEAMANS. I personally hope it will be this way. I think we have to work extremely hard to make it come out that way by both individual restraint in this country and by active use of new technology that will make our energy systems more efficient. My own belief is that we can do this.

Chairman HUMPHREY. Now, if the growth rate in electric demand does moderate, and it actually has moderated even as of now, if it does moderate to the predicted line of between 5 and 6 percent annually, then the question is, can the commercialization of the breeder be delayed as suggested by EPA and, if so, how long?

Mr. SEAMANS. I would prefer not to try to answer that question specifically as to dates. I am not prepared fully to do so. I believe, yes, the commercialization date can be somewhat delayed. I believe, yes, we do have time to take additional stock of the present program. But I don't believe it would be wise to infer from what was said by Mr. Train or in their report that we should delay. I don't believe that what they intend is to delay any work on the breeder program for 10 or 12 years.

Chairman HUMPHREY. That length of delay you think would be excessive?

Mr. SEAMANS. Yes; I think it would be very unwise to introduce a major delay of that sort in our present development program.

Chairman HUMPHREY. Of course, delays always mean that the cost of what you contemplate will most likely go up, the cost of the plant, equipment, and facilities. I think we have to face that.

Would a modest delay, however, based on moderation of electrical demand growth adversely affect the price of electricity? What is your estimate on that?

Mr. SEAMANS. There is some relationship between a delay in the commercialization of the breeder, if that should take place, and the cost of electricity. Because as time goes on, the uranium industry will be mining uranium ore that has less and less uranium content, and hence it will be necessary to mine and process increasing amounts of the raw ore in order to obtain the fuel. So in that sense, the longer we wait the costs will tend to run up.

Chairman HUMPHREY. That gets to the question on uranium supply.

By the way, I would appreciate, just to make note of it, we will drop a letter to you so that it is clear what we want, a brief report for this committee on the impact of breeder reduction rate and the moderation for demand for electricity—in other words, we would like a little more specific information and I will ask the staff to prepare that question.

There are those that say ERDA has conservatively estimated uranium reserves. Uranium now sells for $15 to $20 per pound, it is estimated that it could well rise to $50 or $75 as it seeks equality with high-priced imported oil.

The history of mineral exploration is filled with claims of scarce reserves which disappear as mineral prices rise.

Somehow or other the availability of supply and discovery of new reserves is directly related to the market price.

What specific attempts is ERDA making to locate these ores at depots or locations where in the price range of $50 a pound it could be economically mined? I might add as an auxiliary, how high can the market price of uranium go without resulting in a sizable jump in exploratory activities by wildcatters, so to speak?

Mr. SEAMANS. We have an office in Grand Junction, Colo., which is responsible for assessing what the reserves are in the various categories such as $10 a pound and higher amounts.

We have in our budget this year increased amounts for survey work. I certainly agree that in making decisions, we ought to know what our reserves are before reaching firm decisions on the actions we should take. That goes for all types of fuel including uranium and coal and oil shale and so forth.

The assessment which we released this year indicates that there are somewhat increased amounts of resources at the lower cost than we reported in the previous year, and we so stated.

The ultimate cost of going to the higher price ore will be felt by the user. I would like to supply for the record the detailed relationships.

Chairman HUMPHREY. I wanted to ask you to do that, that was one of the questions.

[The following information was subsequently supplied for the record:]

EFFECT OF URANIUM PRICE ON ELECTRIC GENERATING COSTS

The cost of power from nuclear reactors is relatively insensitive to the price of uranium. The total fuel cost is only about 25 percent of the cost of nuclear power and the cost of uranium is only about 20 percent of that cost. The balance is enrichment, processing fabrication and carrying charges. Therefore, increases in uranium price are not reflected proportionately in the cost of power. However, since electricity demand will be large, the additional cost of using high price uranium would be substantial. Thus, if uranium demand were 50,000 tons U_3O_8 per year, as it may be in 1985, each dollar increase in U_3O_8 price would increase the annual electricity bill by $100 million.

Chairman HUMPHREY. But if we were to find out that our reserves of uranium are significantly greater than now estimated, the question then follows: Could the commercialization of the breeder be delayed beyond 1987, utilizing the existing technology that we have that is not based upon the breeder reactor concept?

Mr. SEAMANS. The answer to that, of course, is "Yes." If we found that we had substantial reserves that we didn't realize we had, then, proportionately, we could increase the time before it is necessary to introduce the breeder. But we are talking about arithmetic increases and it is very doubtful that we would find the geometric increases in reserves that would permit us to keep our present generation systems going on a protracted basis well into the next century.

So, in my view, we must get on with our understanding of the breeder benefits as well as the environmental risks so that we will have those facts when it comes to the next tough decision on whether to commercialize or not.

Chairman HUMPHREY. Of course, all of these questions relate to the tremendous investment required in this type of reactor and the uncertainties of advanced technology.

In our first session we discussed what is going on in other countries in the breeder reactor technology. The question then was, are we coordinating our efforts with the French, for example. Are you dipping in, so to speak, to the technology, to the experimentation, to the results of pilot-plant operations in other countries, or are we going alone here, on our own?

Mr. SEAMANS. The French delegation did visit us recently, and I met with Mr. Giraud who is in charge of their nuclear program. We have had our people in France viewing their Phenix project and other projects, and we should avail ourselves of their developments as well as other developments.

Chairman HUMPHREY. How about the Soviet Union?

Mr. SEAMANS. We have several very good joint projects with them, particularly in the area of fusion and hydrodynamics. Both of these programs, I might say, have benefited this country, I believe, as much as the Soviet Union. It is not a one-way street.

Chairman HUMPHREY. The Washington Post carried an article about 2 weeks ago, April 25, 1975, which described the use of lasers by the Soviets and Americans to enrich uranium to provide fuel for utilities. It is only in the research stage, but it was estimated that it could be developed in 5 years. The staff here checked with ERDA on the process and discovered that lasers could be potentially used to extract all of the U^{235} usable for fuel from uranium deposits. We now get only about two-thirds of the U^{235} with the gaseous diffusion process. It can also be used to extract uranium from waste products which have been thrown away. The result is that this new technology will increase the usable uranium reserves in the United States by over 50 percent. Among other things, this will cut the cost of electricity produced from the present nuclear reactors by up to 10 percent through reduced fuel-processing costs.

Now, with a crash program, how quickly could we see lasers replace the now expensive and inefficient gaseous diffusion process?

Mr. SEAMANS. The issue of what we ought to do about our enriching capability in this country is one that I have been very much involved with in the past month. I think we ought to develop and utilize more advanced technology than we are now using. We should get away from the gaseous diffusion processes as soon as we can because it does not realize the full amount of the energy in the uranium and it also consumes a great deal of energy in the process. My feeling is that we should move first to our centrifuge technology that we have been working on for a long period of time and that we should at the same time put effort on the laser extraction technique which will need funding.

Chairman HUMPHREY. How much funding?

Mr. SEAMANS. I believe we have approximately $35 million next year planned for that.

Chairman HUMPHREY. You are putting a bigger emphasis on this?

Mr. SEAMANS. I think it is misleading to say that the laser separation technology could be available in the form of an operating plant in 5 years. I think, certainly, we like to have within ERDA advocates who are enthusiasts of this kind of activity but there is a great deal of work to be done, particularly in the laser development itself, before we could initiate the design and construction and realize the benefits of this technology.

Chairman HUMPHREY. It is a fact, however, if the laser can be used to extract U^{235} from the waste uranium deposits, that this would have a significant effect upon what we call the usable uranium reserves, isn't that correct?

Mr. SEAMANS. Yes, that is true, about 20 percent.

Chairman HUMPHREY. And, therefore, again would give you an expanded time frame in which to carry out your work in terms of the breeder reactor.

I don't want my own point of view to be misunderstood. I am not an expert on this; the expertise on this belongs with the Joint Committee on Atomic Energy where Senator Pastore and others are working on it. We are primarily concerned here with cost benefit factors.

What we are talking about here is dollars and cents. We are talking about how much money ought to go into this whether or not you can use other processes to get U^{235} out of waste uranium materials, we are talking about whether we can reduce the cost of electricity to the consumer, we are talking about a time frame in which to look toward the commercialization of the breeder reactor. And that gets back to talking about whether or not we could have some delay in the breeder program.

I was wondering, should the delay occur in the Clinch River facility or in the near commercial breeder? Which one should be slowed down, so to speak?

Mr. SEAMANS. Well, in my own thinking, the Clinch River Breeder Reactor is one step along the way to a commercial breeder, and it is a step that provides both licensing and operating experience and added information. I don't believe that we could proceed with the commercialization without having well thought through tests of the demonstration side. I think that if we are going ahead we should proceed with some form of demonstration plant.

Chairman HUMPHREY. Mr. Seamans, what are the Agency's plans to quickly exploit this new technology of laser enrichment? Is the Soviet Union advanced in this, do they have a lead on us or is it on a sort of parallel basis, do you have any idea in that?

Mr. SEAMANS. I know they are very interested in laser technology, have a good program, I can't really assess for you here exactly how they stand with respect to what we are doing. But I believe their work is comparable.

Chairman HUMPHREY. Do we have a joint project with them?

Mr. THORNE. We do not have a joint project with the Russians in the sense of working with them on a common effort. However, we have exchanged unclassified information and technical visits with them on the use of lasers for fusion and for laser isotope separation production. Although there is no conclusive evidence that they are concentrating on using lasers to separate U^{235}, there are indications that they are pursuing that particular application.

Chairman HUMPHREY. We have Mr. Thorne yet to hear from and we have a panel, too. But first let me explore the issue that there may be a disproportionate amount of funding going into the breeder at the expense of geothermal and solar and nonfossil fuel resources. I would like to have you give us your latest cost estimates in the sense of kilowatt hours of electricity produced by alternative sources of energy along with your fiscal 1975 R. & D. expenditures for alternatives, your proposed fiscal 1976 budget, and give us a picture of where you are going, what are the percentages, what would be the results, and what would be the cost estimates in cents-per-kilowatt-hours of alternative fuels. That would be very helpful for our record.

[The following information was subsequently supplied for the record:]

The information requested appears in the Proposed Final Environmental Statement on the LMFBR Program (PFES). For the convenience of the reader, some key statements have been extracted and included in Appendix A of Mr. Thorne's prepared statement. However, as noted elsewhere in this hearing record both the PFES and the comprehensive energy R. & D. plan are under review and/or development. Decisions being made with respect to these two actions could significantly affect the information presented in Appendix A. Reference should be made to both of the aforementioned documents when they are issued in final form.

Chairman HUMPHREY. The EPA pointed out in its breeder critique that radioactive leakage had been reported of plutonium in sites in Kentucky and New York State. These sites were said to be good for 10,000 years and only 10 years have gone since the storage sites were opened. How much plutonium waste do we now annually bury? How much will it be in the year 2020 if the breeder is introduced as scheduled, and is there any way to dispose of plutonium wastes for thousands of years?

Those are long-term projections, but we have to depend on some of you to give us some information on it.

Mr. SEAMANS. We would be happy to supply that information.

[The following information was subsequently supplied for the record:]

Quantities of plutonium wastes (actually special nuclear material) buried annually for the years 1963–1973 are given in the following table. Data for such wastes buried in 1974 are not available at present. These numbers represent only wastes with transuranic contamination greater than 10 MCi/g, buried at commercial burial grounds.

Year:	*Amount (kg)* [1]
1963	~45.0
1964	~190.0
1965	341.5
1966	~20.0
1967	~45.0
1968	~30.0
1969	~50.0
1970	~70.0
1971	~145.0
1972	~170.0
1973	~150.0

[1] Source: "A Summary of Low-Level Radioactive Wastes Buried at Commercial Sites Between 1962 and 1973, With Projections to the Year 2000," M. F. O'Connel and W. F. Holcomb, Radiation Data and Reports, vol. 15, No. 12, December 1974.

Plutonium wastes would not be buried in commercial burial grounds in the year 2020. Instead, they would go to either a temporary surface storage or permanent disposal facility. ERDA is studying retrievable surface storage of transuranic wastes as an interim measure, pending selection of the permanent disposal concept to be employed. The evaluation of promising geological formations and sites leading to a pilot geological repository, which in turn could lead to a permanent disposal system, is a major part of the ERDA radioactive waste program. At present, ERDA plans further study of several promising geologic formations other than bedded salt, including study of specific promising sites, to bring the state of knowledge of these other formations up to the same level as that of bedded salt. The goal of this further study is to permit a comparative evaluation of these formations and the selection of the optimum formation or formations for pilot plant operations.

It can be estimated that the annual production of plutonium wastes (transuranic contaminated wastes and cladding hulls) in the year 2020 would be less than 100.000 kg.

Chairman HUMPHREY. What are your general views about this leakage? Is it serious?

Mr. SEAMANS. First, on the whole matter of storage, anybody who claimed that they were storing waste for 10,000 years or in that order of magnitude didn't understand the problem. As far as I know, we never claimed that we were storing for that period of time.

We are very concerned about permanent storage. We have work underway, it has been underway for some time, but we are accelerating the work on storage, including the permanent storage.

This is an item that we have discussed with the French, the Swedes, and with other foreign countries, and we are gathering information here at home. I am personally not satisfied with the record to date, but I believe to date there has been no serious accident and no impairment of safety of other individuals. I would like to have Mr. Thorne comment to the specifics of the question.

Chairman HUMPHREY. You might want to do that in your own statement, Mr. Thorne, so that we can let Mr. Seamans go.

Congressman Bolling.

Representative BOLLING. Nothing further.

Chairman HUMPHREY. Mr. Long.

Mr. LONG. No questions.

Chairman HUMPHREY. Mr. Seamans, you do have to leave. You have been most cooperative and you may leave.

I have some additional questions I would like to submit to you in writing, if you don't mind.

Mr. SEAMANS. Not at all.

[The following questions and answers were subsequently supplied for the record:]

RESPONSE OF HON. ROBERT C. SEAMANS, JR., TO ADDITIONAL WRITTEN QUESTIONS POSED BY CHAIRMAN HUMPHREY

Question 1. What are the costs of decommissioning nuclear plants at the end of their useful life?

Answer. The Gulf United Nuclear Corporation provided preliminary cost estimates in 1974 for two methods of decommissioning 1100 MWe plants, complete removal of the plant (and restoration to approximately original site conditions) and removing the highly radioactive materials and entombing the remaining radioactive material at the site. The 30 year levelized penalty to the LWR fuel cycle would be approximately 1% of the original construction cost for removal and considerably less for entombment. An independent estimate reported by Stoller Associates in a 1974 study conducted for the Long Island Power and Light Co. indicated a total fuel cycle penalty cost range of 0.03 to 0.7 mills/kWhr on a present worth basis (cost range of 2 million to 45 million dollars in 1974) with a most probable value between 0.1 and 0.2 mills/kWhr to cover the ultimate cost of decommissioning a nuclear power plant.

Question 2. What are the costs of nuclear waste disposal?

Answer. It is not possible at this time to estimate precisely the total cost of safely managing commercial radioactive waste because the processes which will be used to reduce volume and convert the waste to appropriate forms are still being developed and the cost of building and operating the facilities for the selected treatments can only be approximated at this time. Also, methods for interim and final storage are yet to be selected and construction as well as transportation costs can only be estimated.

However, the information already available from experimental work and engineering design studies allows reasonable predictions of the range of total costs for managing the high-level waste and the transuranium contaminated solid waste (both of which require long-term isolation from man's environment) through the end of this century. These costs, when spread over the amount of electricity projected to be generated by nuclear power reactors through the year 2000, average about 0.1 mills per kWhr. The uncertainties in these estimates are such that the figure could run as high as 0.2 mills per kWhr. It should be noted that these costs will be borne by consumers of electricity, rather than taxpayers generally, because it is ERDA policy to levy a charge on waste delivered to the Federal Repository. This charge is designed to defray all costs of disposal and perpetual surveillance as specified in Appendix F of 19 CFR 50.

Question 3. What are the costs of nuclear safeguard programs and devices for nuclear power plants?

Answer. Preliminary estimates of the costs of safeguard measures indicate that the operating costs of safeguards with a high level of effectiveness will be less than 2 percent of the total operating costs of a large (80,000-MWe) LMFBR fuel cycle module and the capital costs of safeguards equipment will be less than 1 percent of the LMFBR fuel cycle capital costs.

These LMFBR safeguards costs are given in the following table.

LMFBR Module safeguards cost summary:

	Cost
Total capital equipment, millions	$280
Operating costs (per year) millions:	
Security personnel	49.3
Fixed charge of capital investment (at 16 percent per year)	43.7
Prorated costs of regulatory operations	4.0
Other operating costs (materials, power, fuel, etc.)	5.0
Total operating costs	102.0
Percentage increase in module capital costs due to safeguards	0.67
Percentage increase in module operating costs due to safeguards	1.40
Increase in module nuclear electric power costs due to safeguards, mills/kWhr	0.18

Summarizing these costs:

	Mills/kWhr
Decommissioning	0.1–0.2
Waste management	0.1–0.2
Safeguards	about 0.2
Total	0.4–0.6

NOTE.—The total cost of electric power in the years 1970–2000 is expected to average about 13 mills/kWhr.

Chairman HUMPHREY. We will now hear from Mr. Thorne. You have a statement, I believe?

Mr. THORNE. Yes.

Chairman HUMPHREY. Would you take a few minutes to highlight some of the key points you wish to make in that statement? We have a panel that follows you and we want to get the advantage of their observations here today. I would like to have your thoughts in this record so that the panel itself can comment on some of your observations.

We will include the full text of your statement in our record.

You have heard some questions that my colleagues have asked. We are concerned about the financial cost overruns; we are concerned about the availability of the uranium reserves; we are concerned, for example, when we read that the electric industry itself was not particularly excited about the breeder, feeling that it is premature. For example, a representative of the Illinois Power Co. was quoted in the Wall Street Journal as saying there is a significant lack of interest in the Clinch River project among utility people. Then there have been statements in other electrical journals showing lack of real interest on the part of the large utilities.

Of course, there is tremendous concern over the cost involved. This small demonstration reactor at Clinch River is to be built with $1.4 billion of Government funds and $268 million in the private industry capital. That is on the development schedule, as I understand it. There is reason to be concerned as to whether or not the private sector is really going to come in with their share of the capital, particularly when you get to what you call the near commercial breeder—the second demonstration breeder stage.

Those are some of the things that we are interested in and I imagine you allude to many of those things in your statement.

Mr. THORNE. Yes, sir. With the chairman's permission I will try to highlight that statement.

Chairman HUMPHREY. The history of the breeder, I think, we are pretty familiar with. The areas I would like you to highlight are the program objectives, the availability of resources, and the cost of the breeder.

STATEMENT OF ROBERT D. THORNE, ACTING DEPUTY ASSISTANT ADMINISTRATOR FOR NUCLEAR ENERGY, ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION

Mr. THORNE. The LMFBR program is a technology-to-commercialization program. Consequently, the program incorporates broad research and development and engineering bases with the extensive industrial involvement required to establish a competitive commercial breeder industry. The breeder program has been built upon the 50 reactor years of U.S. experience with liquid metal plants and upon the more than 200 reactor years of experience gained with the current light water cooled reactors.

I might add that yesterday Mr. Russell Train, before the Joint Committee on Atomic Energy, endorsed the commercialization of the program, his question relates more to the timing of commercialization.

Development and demonstration of breeder technology requires many facilities to support the program. For example, the fast flux test facility (FFTF) being constructed in Richland, Wash., will test breeder fuels, materials, and instrumentation in a liquid sodium environment. In addition, test facilities are required to experimentally investigate the safety, component reliability, and operational aspects of the breeder. Major facilities are planned for future years as the program progresses toward commercialization.

A next key step after FFTF in the progress toward commercialization is the building of an energy producing demonstration plant, which is the Clinch River Rreeder Recator (CRBR). This plant, which is about one-third the size of commercial reactor plants being procured today, will provide an opportunity for the breeder technology and components, developed and demonstrated by earlier plants and facilities, to be applied to a single system for the production and delivery of electricity on a utility grid. Successful demonstration is essential to assure utilities that the breeder is an operable and commerically attractive power plant. Over 700 utility companies have pledged $258 million to the demonstration project, and in return they will receive information, training, and the use of data developed in the course of the project so that they will begin to be prepared to incorporate the breeder reactor into their operations. However, beyond CRBR it will be necessary for ERDA and the private sector to jointly build a breeder reactor and power generating system of about the anticipated size of commercial plants. It is only then that the commercial benefits of the breeder can begin to be realized.

Chairman HUMPHREY. The financing at that point will be what, sir?

Mr. THORNE. Our planning in the past was that it would be basically a Government-sponsored and funded facility, although we would intend to incorporate the same basic framework that we have with the Clinch River Breeder Recator and invite participation to the extent it could be brought in.

Chairman HUMPHREY. But if the private utility market does not come in, the real fact is that it will be done with Government funds?

Mr. THORNE. Yes, sir.

Chairman HUMPHREY. It is at that point that I think many of the Members of Congress are especially concerned. We are concerned about safety factors, the hazards and the environmental pollution problems; but the cost overruns which constantly face us and the estimates made by GAO especially bother us. The last estimates that we had, as I recall, didn't have any inflation factor built in to them at all beyond 1976. Of course, the early cost estimates were just pie in the sky, so to speak. They weren't related to reality at all. So what you are talking about here that it will be necessary for ERDA and the private sector to jointly build a breeder reactor about the anticipated size of commercial plants, I think what we want to know in this committee is what the estimates of costs are going to be.

Do you really believe the private sector will put much money into it, and if so, how much? If they don't, the plans are for it to be governmentally funded, and if it is going to be governmentally funded, what cost level are we looking at? It is imperative in the budget process to know this. We are going to have to have those estimates on a much more accurate basis.

I recognize new technology is always unpredictable in terms of cost. We are sufficiently experienced in this to know that you can't really give a totally accurate picture.

Mr. THORNE. If I may comment on that, certainly there has been a substantial problem in the past of estimating the cost of a project. One of the problems has been that the cost estimates have been used on very generalized concepts. As time goes on, as the design becomes more definitive, and as people recognize what the real rate of inflation is, then the cost estimates change. I think it ought to be recognized that it is very difficult to predict many years ahead what the cost of a project would be.

Cost estimates that increase over the years are not unique to this project, it is apparent in every large project the Government has carried out in the last few years.

In looking at the commercial breeder reactor we are continuously in the process of defining what that reactor will be. We have a program underway to provide the design parameters for the reactor and its generating system and we believe the cost estimates that flow out of that design will be reasonably good. I cannot assure you that we can give you the precise cost, but I believe we can give you a reasonably good cost.

Chairman HUMPHREY. Our concern goes back to the SST. You get involved to a certain point and do you continue your involvement because you have put so much into it, or do you cancel it out. It is the judgment of some that the enthusiasts for the breeder came in with such low estimates that Congress said, "Why, it is such a small amount, why not try it". It is the old idea of the camel's nose goes under the tent and pretty soon the whole animal walks in. The cost is astronomical.

I will tell you right now, there has to be a greater preciseness on the part of cost estimates, taking into consideration your honest judgment that there may well be factors which are not measurable now due to uncertainties and the lack of precise information about certain types of technology. But we need to be told what those considerations and judgments are so we don't think we are getting this new facility at a very small down payment, and it looks like you can just handle it and it isn't going to amount to much.

Mr. THORNE. I understand that. That is one of the reasons why, in trying to define the design considerations for the near commercial plant, we will not come to Congress to ask them to fund the Government portion of the project until we are sure that we have the project tied down, we know where the certainties and uncertainties are and we can so identify that to the Congress, and we know what the utility industry interest is in the project. If the utilities do not feel it is commercially attractive and needed, we, in all probability, would not proceed with the project.

Chairman HUMPHREY. You could use past examples as a way of making some projections, I am sure.

Go right ahead.

Mr. THORNE. If I might comment now on the availability of uranium. The economically recoverable supplies of uranium to fuel the light-water nuclear power reactors are limited. However, and by the mid-1980's it is projected that proven domestic reserves of high grade low cost, uranium ore will be committed to guarantee a lifetime supply for nuclear power plants purchased by that time. Shown in figure of my prepared statement are the currently estimated known reserves and potential resources of uranium in the United States. Reserves are defined as quantities of uranium in known ore deposits that can be recovered within a stated cost using current mining and processing techniques. Potential resources are defined as quantities of uranium that are surmised to occur in unexplored extensions of known deposits or in undiscovered deposits in other favorable areas.

Potential domestic resources of high grade ore are projected to be sufficient to meet U.S. needs into the turn of the century. It must also be recognized that three-quarters of the currently estimated potential resources have yet to be discovered. There is, of course, the possibility that they will prove to be less than the estimates, which would result in a shortfall in supply at an earlier date. At the time that all reasonably economically recoverable resources become committed, the utility industry could be reluctant to purchase additional nuclear plants since there would be no assurance that enough domestic uranium would be available to fuel the plants over their lifetimes.

Only about 1 percent of the energy available in uranium is recovered from the fuel of today's nuclear power plants. However, the fast breeder reactor converts, or breeds, depleted uranium into plutonium, a usable fuel. The plutonium is produced at a rate that will fuel more reactors. Thus, the utilization of uranium is increased to at least 60 percent. Also, current light water reactors cannot effectively use the most plentiful isotope of uranium, U-238, which is the depleted uranium byproduct of the uranium enrichment process. All of this depleted uranium needed for LMFBR's for at least the next 100 years has already been mined and is in Government stockpiles. A long term and low cost fuel supply is assured.

Chairman HUMPHREY. We asked questions of Mr. Seamans on that and you apparently concur with Mr. Seaman's responses, in terms of when the market price got up to $50 a pound you would have more resources available, is that correct?

Mr. THORNE. Yes, sir, in all probability. However a more key element in the availability of uranium is the cost of production of the uranium. As Mr. Seamans said, if higher cost deposits are mined then the price of uranium will increase.

Chairman HUMPHREY. The price and the discovery of resources seem to be correlated.

Mr. THORNE. Absolutely.

Chairman HUMPHREY. And new techniques will be developed for mining.

Mr. THORNE. Yes, sir, they are.

Chairman HUMPHREY. Are we relying primarily on domestic uranium?

Mr. THORNE. Yes, sir.

Chairman HUMPHREY. There are vast quantities of uranium that can be imported, is that correct?

Mr. THORNE. Yes, sir. There are vast quantities in Canada, Australia, and other parts of the world. But our focus in terms of resource self-sufficiency is in this country and we are looking upon finding domestic supplies of the uranium required to support our nuclear industry.

Chairman HUMPHREY. I think some of this attitude from friends and neighbors like Canada is related to the fear of the lack of energy resources. But if new technologies reveal that there are greater resources than estimated, the tendency might well be relaxed to cut off exports. This is particularly true if that laser technology comes through where you can increase substantially your uranium resources that you showed on the chart here, isn't it?

Mr. THORNE. Yes, the utilization of known resources would be increased, but even doubling the amount of known resources in this country really only makes a difference of adding a few years in terms of the uranium needs of light-water reactors, after the year 2000. So you don't substantially improve the supply situation.

Chairman HUMPHREY. All right, go right ahead, sir.

Mr. THORNE. I might talk a bit about nuclear power and major project cost estimates. That is, I understand, a major question raised by this committee.

Today, the domestic nuclear power industry is a growing industry with capital investments totaling over $100 billion and projected fuel investments of over $200 billion. Nuclear power now accounts for about 8 percent of the electrical generating capacity in our country.

When the plants under construction and on order become operational over the next 10 years, the nuclear share of the electrical capacity will increase to about 25 percent. This growth rate is attributable to the environmental and competitive advantage which nuclear power now enjoys in the cost of generating electricity. This advantage is due to low uranium fuel costs as compared to fossil fuels. Although the initial investment in a nuclear plant is larger—one reason utilities have delayed plans for nuclear capacity during the current economic climate when money for capital investment is not readily available—in the long run, the power cost is much less for nuclear. Consequently, many utilities believe that nuclear power is the best long-term investment.

Furthermore, because a 1000 WMe nuclear plant saves an equivalent of 9 million barrels of oil annually, by 1985 the projected operation of 200 nuclear plants could reduce our dependency on oil imports by the equivalent of 4½ million barrels of oil per day.

The current cost benefit studies on the LMFBR program indicate that with the availability of the LMFBR, nuclear power would cost about one-third less shortly after the turn of the century than it would without the breeder. As shown in figure 2 of my prepared statement the economic benefits accrue principally because it will not be necessary to mine low-grade, high-cost uranium ores or to build additional capacity for processing the uranium. The total annual savings in consumer electric bills in the year 2020 from the fast breeder reactor is estimated at $50 to $100 billion in 1975 dollars.

The main benefit from the breeder is essentially zero cost fuel and better utilization of known resources. The breeder produces its own fuel, supports the breeder economy and uses the stockpiles of depleted uranium as the target fuel to produce plutonium. The fuel costs are substantially less and this is what makes the LMFBR potentially attractive to the utility industry.

The LMFBR program has concentrated on advancing the technology of the breeder. Years of research and development are to be embodied in the FFTF and CRBR. They are only parts, albeit very significant parts, of the total program.

It is important to note that the missions of the FFTF and the CRBR demonstration plant are different but complementary. The FFTF will provide the test bed for the continuing development of improved core components, and the CRBR will provide the practical operating and maintenance experience essential to licensing and commercializing the breeder concept. The CRBR demonstration plant will meet the objectives of electric utility interests for operating reliability, availability, maintainability and economics.

The CRBR project was initiated on January 13, 1972 by agreement among the United States Atomic Energy Commission, the Tennessee Valley Authority, the Commonwealth Edison Co., and the Project Management Corp. Several major accomplishments have been realized in the last 3 years: Contractual arrangements have been finalized; a significant, but fixed, financial participation of the electric utility industry has been secured; the reference design and general specifications for the plant have been completed; basic contracts have been negotiated with the reactor manufacturers and architect engineers; and streamlining of the management of the project is being implemented. As is evident from these accomplishments, the basic groundwork has been laid for project execution.

Regarding the LMFBR program cost estimates, these estimates focus on a period from 1950 to the year 2020–70 years. It is not often that one even attempts to make an estimate over such a long period, particularly of a very complex undertaking. It has been my experience that cost estimates based over a long time and upon very generalized design criteria and assumptions are not very valid; the validity increases with time, more knowledge and better design criteria. Consequently, it is not surprising to me that the past LMFBR program and project estimates vary substantially.

There have been three recent updates of the LMFBR program cost estimate. These are summarized in table 1 of my prepared statement. Note the differing assumptions or conditions used for each projection. The most significant assumptions are the value of the dollar used, the period of years covered and the date assumed for commercial operations.

Escalation experienced since 1968 has had a significant impact on these projections. For example, a comparison of the current estimate in 1968 versus 1976 dollars shows that $3.6 billion had to be added to the projections just to account for escalation since 1968.

The FFTF project is experiencing substantial inflationary growth in costs of material and labor, in addition to adverse market conditions in availability of materials. Area wide labor disputes over contract settlements have directly impacted the project schedule. On the basis of these current trends, the project is forecasting a cost of $622 million—an increase of $92 million—and a schedule completion date of August 1978—a slippage of 9 months.

The $92 million increase which is being forecasted includes $78 million of cost growth already experienced or allocated. Of the $78 million growth, $12 million is attributable to design evolution since 1973, $24 million is due to low estimating caused by the first-of-a-kind nature of certain aspects of the project, and $42 million was caused by escalation and unusual market conditions.

As an example of the escalation experienced, labor negotiations in 1974 have resulted in settlements ranging from 38 to 48 percent hourly wage rate increases for essential crafts over the next 2 years. Comparable increases are anticipated on contracts to be negotiated in the coming year. This is substantially higher than the 5.5-percent-per-year forecast in 1973. The $622 million forecast still includes $88 million of escalation and contingency for presently unidentified growth. Major attention by all FFTF contractors continues to be focused on ways to better control the project and to recover the forecasted cost growth and schedule slippages.

Chairman HUMPHREY. Because of inflation?

Mr. THORNE. Yes, sir. The other changes were due to improvements in the design by further definition of the design criteria and increasing the safety of the reactor. So a combination of design changes, changes to the program structure and inflation and escalation has accounted for the basic increase.

Chairman HUMPHREY. The only point that I make is that your program projections from 1976 on did not include an inflation factor and I think that is unrealistic.

Mr. THORNE. I agree. The latest projection for CRBR and FFTF includes an inflation increase of 8-percent-per-year average. The total period is averaged out at 8-percent-per-year escalation.

Chairman HUMPHREY. I would also include the increased cost of materials because the raw materials are as much a part of the day as the sunshine out here. Because other countries have learned from OPEC that the day of cheap metals is over. The prices are obviously going to be manipulated and controlled. These raw material producing countries are not stupid and they learned a lot of things from us and they are applying them to us. They understand fixed prices, they don't believe in the competitive system. They know how to administer the price. Wouldn't you agree that is going to be a fact?

Mr. THORNE. Yes, sir, we are experiencing that now. The cost of materials and wage rates are substantially impacting us.

If there are no further questions, I think that summarizes my statement.

Chairman HUMPHREY. I thank you very much for coming.

Mr. THORNE. Thank you.

[The prepared statement of Mr. Thorne follows:]

PREPARED STATEMENT OF ROBERT D. THORNE

Mr. Chairman and members of the Committee: Thank you for this opportunity to appear and to discuss several of the aspects of the Liquid Metal Fast Breeder Reactor (LMFBR) development program sponsored by the Energy Research and Development Administration (ERDA). I welcome this opportunity to provide information which will assist the Committee in considering the breeder issue in an unbiased and unemotional way. There is an urgent need for forums such as this for a balanced discussion of our Nation's energy options and their impact upon our way of life.

Because of the limited time that is available this morning, I do not propose to provide a detailed discussion of all aspects of the LMFBR program. Rather, I will concentrate on those topics that I believe are of the greatest interest to the Committee. These include the Program objectives, the availability of the uranium resource, the benefits and costs of the breeder and the role and costs of two of the principal LMFBR projects—the Fast Flux Test Facility (FFTF) and the Clinch River Breeder Reactor (CRBR). I will then conclude with a brief discussion of the future demands for electricity and alternatives to the breeder.

HISTORY OF BREEDER

The breeder program dates back to the Manhattan Engineer District days of the early 1940's when experimental evidence led to the conclusion that the breeding of nuclear fuel appeared possible in a reactor operating with fast neutrons. In 1946 the first fast reactor, Clementine, was operated, and during more than seven years of operation it proved that a fast reactor could operate reliably. On December 20, 1951, the Experimental Breeder Reactor–I (EBR–I) generated electricity from nuclear energy, for the first time in the world, and during subsequent years of operation EBR–I demonstrated the feasibility of breeding, the technology of using liquid metal as a coolant, and the inherent stability of fast reactors. Since 1951, numerous other breeder test reactors have been constructed and operated in this country and abroad. U.S. experience totals about 50 reactor years with liquid metal fast reactors; total foreign experience is about the same.

OBJECTIVES AND STRUCTURE OF THE CURRENT U.S. LMFBR PROGRAM

The LMFBR Program is a technology-to-commercialization program. Consequently, the Program incorporates broad research and development and engineering bases with the extensive industrial involvement required to establish a competitive commercial breeder industry. The breeder program has been built upon the 50 reactor years of U.S. experience with liquid metal plants and upon the more than 200 reactor years of experience gained with the current light water cooled reactors. Development and demonstration of breeder technology requires many facilities to support the program. For example, the Fast Flux Test Facility (FFTF) being constructed in Richland, Washington, will test breeder fuels, materials, and instrumentation in a liquid sodium environment. In addition, test facilities are required to experimentally investigate the safety, component reliability, and operational aspects of the breeder. Major facilities are planned for future years as the Program progresses toward commercialization.

A next key step after FFTF in the progress toward commercialization is the building of an energy producing demonstration plant, which is the Clinch River Breeder Reactor (CRBR). This plant, which is about one-third the size of commercial plants being procured today, will provide an opportunity for the breeder technology and components, developed and demonstrated by earlier plants and facilities, to be applied to a single system for the production and delivery of electricity on a utility grid. Successful demonstration is essential to assure utilities that the breeder is an operable and commercially attractive power plant. Over 700 utility companies have pledged $258 million to the demonstration project, and in return they will receive information, training, and the use of data developed in the course of the project so that they will begin to be prepared to incorporate the breeder reactor into their operations. However, beyond CRBR it will be necessary for ERDA and the private sector to jointly build a breeder reactor and power generating system of about the anticipated size of commercial plants. It is only then that the commercial benefits of the breeder can begin to be realized.

AVAILABILITY OF URANIUM

Economically recoverable supplies of uranium to fuel the light water nuclear power reactors are limited, however, and by the mid 1980's it is projected that proven domestic reserves of high grade uranium ore will be committed to guarantee a lifetime supply for nuclear power plants purchased by that time. Shown in Figure 1 are the currently estimated "known reserves" and "potential resources" of uranium in the U.S. Reserves are defined as quantities of uranium in *known* ore deposits that can be recovered within a stated cost using current mining and processing techniques. Potential resources are defined as quantities of uranium that are *surmised* to occur in unexplored extensions of known deposits, or in undiscovered deposits in other favorable areas.

Potential domestic resources of high grade ore are projected to be sufficient to meet U.S. needs into the turn of the century. It must also be recognized that three-quarters of the currently estimated potential resources have yet to be discovered. There is, of course, the possibility that they will prove to be less than the estimates, which would result in a shortfall in supply at an earlier date. At the time that all reasonably economically recoverable resources become committed, the utility industry could be reluctant to purchase additional nuclear plants since there would be no assurance that enough domestic uranium would be available to fuel the plants over their lifetimes.

Only about 1% of the energy available in uranium is recovered from the fuel of today's nuclear power plants. However, the fast breeder reactor converts, or breeds, depleted uranium into plutonium, a usable fuel. The plutonium is produced at a rate that will fuel more reactors. Thus, the utilization of uranium is increased to at least 60%. Current light water reactors cannot effectively use the most plentiful isotope of uranium which is a byproduct of uranium enrichment for today's reactors. All of the uranium needed for LMFBR's for at least the next 100 years has already been mined and is in Government stockpiles. A long term and low cost fuel supply is assured.

BENEFITS FROM NUCLEAR POWER AND THE NEED FOR THE LMFBR

Today, the domestic nuclear power industry is a growing industry with capital investments totaling over $100 billion and projected fuel investments of over $200 billion. Nuclear power now accounts for about 8% of the electrical generating capacity in our country. When the plants under construction and on order become operational over the next ten years, the nuclear share of the electrical capacity will increase to about 25%. This growth rate is attributable to the environmental and competitive advantage which nuclear power now enjoys in the cost of generating electricity. This advantage is due to low uranium fuel costs as compared to fossil fuels. Although the initial investment in a nuclear plant is larger—one reason utilities have delayed plans for nuclear capacity during the current economic climate when money for capital investment is not readily available—in the long run, the power cost is much less for nuclear. Consequently, many utilities believe that nuclear power is the best long term investment. Further, because a 1,000 MWe nuclear plant saves an equivalent of 9 million barrels of oil annually, by 1985 the projected operation of 200 nuclear plants could reduce our dependency on oil imports by the equivalent of 4½ million barrels of oil per day.

The current cost-benefit studies on the LMFBR Program indicates that with the availability of the LMFBR, nuclear power would cost about one-third less shortly after the turn of the century than it would without the breeder. As shown in this next chart (Figure 2), the economic benefits accrue principally because it will not be necessary to mine low-grade uranium ores or to build additional capacity for processing the uranium. The total annual savings in consumer electric bills in the year 2020 from the Fast Breeder Reactor is estimated at $50 to $100 billion (1975 dollars).

In addition to these economic benefits which will be felt directly in reduced costs to the consumer, the commercialization of the LMFBR by our Nation will continue the technological leadership which our country currently enjoys in the world market for nuclear power. The continued foreign sales of U.S. engineered nuclear plants is an important balance of payments benefit that should be considered. Other benefits which are fully discussed in the LMFBR Environmental Impact Statement include reduced environmental impact of the generation of electricity and reduced occupational injuries and fatalities.

FUNCTION AND STATUS OF THE FAST FLUX TEST FACILITY (FFTF) AND THE CLINCH RIVER BREEDER REACTOR (CRBR)

As I previously described, the U.S. LMFBR program has concentrated on advancing the technology of the breeder. Years of research and development are to be embodied in the FFTF and CRBR. They are only parts, albeit very significant parts, of the total program.

It is important to note that the missions of the FFTF and the CRBR demonstration plant are different but complementary. The FFTF will provide the test bed for the continuing development of improved core components, and the CRBR will provide the practical operating and maintenance experience essential to commercializing the breeder concept.

The CRBR demonstration plant will meet the objectives of electric utility interests for operating reliability, availability, maintainability and economics.

The CRBR project was initiated on January 13, 1972 by agreement among the United States Atomic Energy Commission, the Tennessee Valley Authority, the Commonwealth Edison Company, and the Project Management Corporation. Several major accomplishments have been realized in the last three years: contractual arrangements have been finalized; a significant, but fixed, financial participation of the electric utility industry has been secured; the reference design and general specifications for the plant have been completed; basic contracts have been negotiated with the reactor manufacturers and architect engineers; and streamlining of the management of the project is being implemented. As is evident from these accomplishments, the basic groundwork has been laid for project execution.

LMFBR PROGRAM COST

A number of questions have been raised regarding increases in the LMFBR program cost estimates and statements have been made that the program has experienced unprecedented "overruns."

These estimates focus on a period from 1950 to the year 2020—*70 years*. It is not often that one even attempts to make an estimate over such a long period, particularly of a very complex undertaking. It has been my experience that cost estimates based upon very generalized design criteria and assumptions are not very valid; the validity increases with more knowledge and better design criteria. Consequently, it is not surprising to me that the estimates vary substantially.

There have been three recent updates of the LMFBR program cost estimate. These are summarized in Figure 3. Note the differing assumptions or conditions used for each projection. Of most significance is the value of the dollar used, the period of years covered and the date assumed for commercial operations.

TABLE 1.—COMPARISONS OF LMFBR PROGRAM COST PROJECTIONS

[In billions of dollars]

	Original estimate	Environmental statement	Program review report
LMFBR base program	2.0	5.1	5.6
Supporting technology	1.3	3.0	3.3
Subtotal	3.3	8.1	8.9
Cumulative costs	.5	1.7	1.7
Total program	3.8	9.8	10.6
Assumptions:			
Year dollars used	1968	1975	1976
Period covered	1970–2020	1975–2020	1975–2020
1st commercial plant operations	1984	1987	1987

Escalation experienced since 1968 has had a significant impact on these projections. For example, a comparison of the current estimate in 1968 vs. 1976 dollars shows that $3.6 billion had to be added to the projections just to account for escalation since 1968.

FFTF project

The FFTF project is experiencing substantial inflationary growth in costs of material and labor, in addition to adverse market conditions in availability of materials. Area wide labor disputes over contract settlements have directly impacted the project schedule. On the basis of these current trends, the project is forecasting a cost of $622 million (an increase of $92 million) and a schedule completion date of August 1978 (a slippage of 9 months).

The $92 million increase which is being forecasted includes $78 million of cost growth already experienced or allocated. Of the $78 million growth, $12 million is attributable to design evolution since 1973, $24 million is due to low estimating caused by the first-of-a-kind nature of certain aspects of the project, and $42 million was caused by escalation and unusual market conditions. As an example of the escalation experienced, labor negotiations in 1974 have resulted in settlements ranging from 38 to 48% hourly wage rate increases for essential crafts over the next two years. Comparable increases are anticipated on contracts to be negotiated in the coming year. This is substantially higher than the 5.5% per year forecast in 1973. The $622 million forecast still includes $88 million of escalation and contingency for presently unidentified growth. Major attention by all FFTF contractors continues to be focused on ways to better control the project and to recover the forecasted cost growth and schedule slippages.

CRBR project

The cost of the Clinch River Breeder Reactor (CRBR) project is currently estimated at $1.736 billion. The original estimate was $699 million. The actual plant investment cost is $1.202 billion with the remainder attributed to research and development and five years of operation.

A reestimate of the CRBR cost was made in 1974 based on a reference design and schedule for the plant which was much more detailed than the 1972 design. The estimate of 1972 was based on conceptual design ideas extracted from three independent contractor designs. As opposed to the generalized design base for the 1972 estimate, the 1974 cost estimate is traceable, on a line-by-line basis, to a definitive design for the total plant. The 1974 reference design represents design evolution and much greater degree of definition and was developed upon in-depth investigations of design alternatives and trade-off studies to achieve an optimized design and an effective technical approach.

FUTURE DEMANDS FOR ELECTRICITY AND ALTERNATIVES TO THE BREEDER

Electrical demand

From today's perspective of high fossil fuel prices, rapidly rising electric energy prices, dependence on foreign sources for much of our fuel, and a declining national economy, this country is moving to reduce our demands for energy. ERDA is undertaking a vigorous research and development program of conservation and for more efficient uses of our energy resources. Even with conservation measures it is clear that electrical energy will increasingly continue to satisfy a share of the energy demand.

Most of the energy projections assume that a large share of the electricity demand will be met by fossil fuels. Our fossil resources also are needed as the feedstock for the petrochemical industry where there is no known substitute. It may not be wise to continue to use fossil fuels where other resources can be used. We may want to substitute other fuels for our fossil fuels in electrical production so as to preserve our fossil resources for other essential uses for which there is no known substitute.

Nonfission options

Various estimates have been advanced as to the impact which non-fission technology alternatives may have in our future. The principal options are power from solar and geothermal heat and the fusion of hydrogen. Some of these technologies are in the laboratory in the embryonic state of development and others require major technological improvements to become practical viable options. I strongly believe that our Nation cannot afford to overlook or abandon *any* promising energy option. We will need them all and the contributions that each can make if we are to continue to enjoy the benefits of adequate, if not abundant, energy.

I would note, though, that the LMFBR is a technology that is out of the laboratory and is now at the point where it is ready for commercial viability within the next two decades.

Adequate funding for alternatives

Non-fission programs will be funded at a rate consistent with their promise, technological maturity, and need. Certain of these programs—conservation, fossil, fusion, solar and geothermal to name several—are being greatly expanded over previous years. It is important to note that fossil and light water nuclear plant generation of electricity are the relatively mature technologies with which we are dealing. The rest are new. They are at various stages of the maturation process. Their penetration of the market will be from one to several decades hence.

The results of ERDA's review which was mentioned earlier may require that changes be made in our budget to ensure an effective energy program with proper balance. We will not hesitate to request the Congress to make those changes to assure that we are responsive to the Nation's needs.

CONCLUSION

Mr. Chairman, I believe that the LMFBR option offers the Nation a well-advanced technology which when fully commercialized will be a safe, clean, reliable and economic electric power generation system. The potential advantages of the LMFBR at this point in time certainly appear to far outweigh its disadvantages. While there are recognized problems, they are solvable without adverse effects to public health and safety. We will continue to assure that this program is responsive to the needs of the Nation and the consumers.

Thank you again for this opportunity to testify before the Committee. I would be pleased to answer any questions you may have.

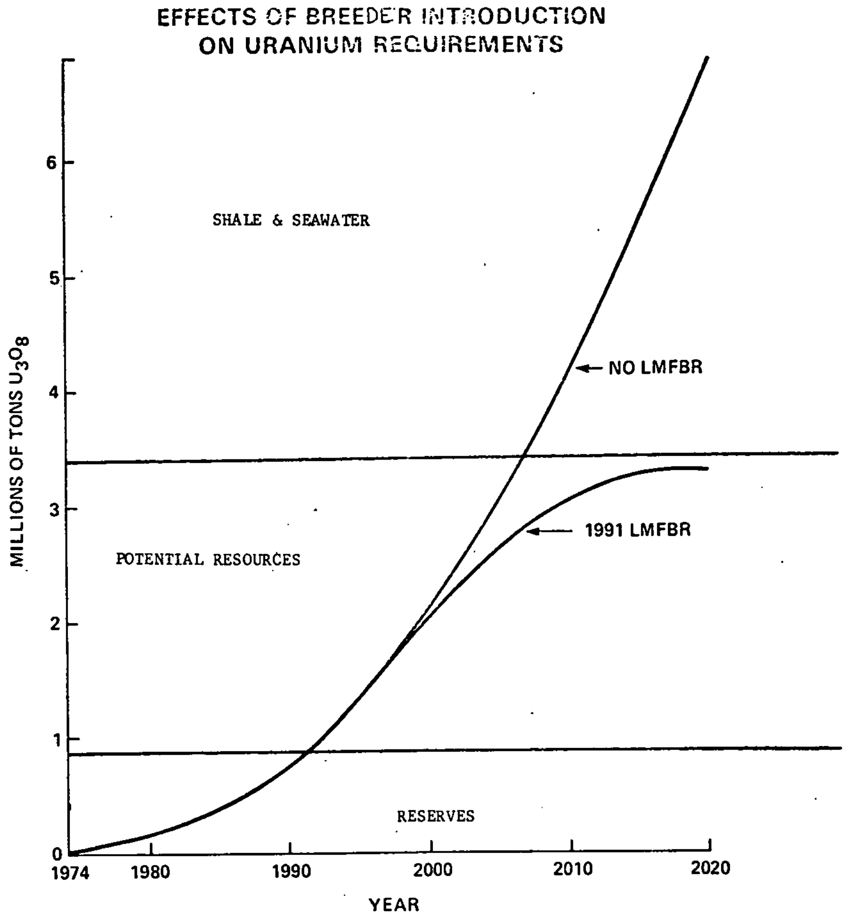
EFFECTS OF BREEDER INTRODUCTION
ON URANIUM REQUIREMENTS
SHALE & SEAWATER
NO LMFBR
POTENTIAL RESOURCES
1991 LMFBR
RESERVES
MILLIONS OF TONS U_3O_8
0
1
2
3
4
5
6
1974
1980
1990
2000
2010
2020
YEAR

FIGURE 1

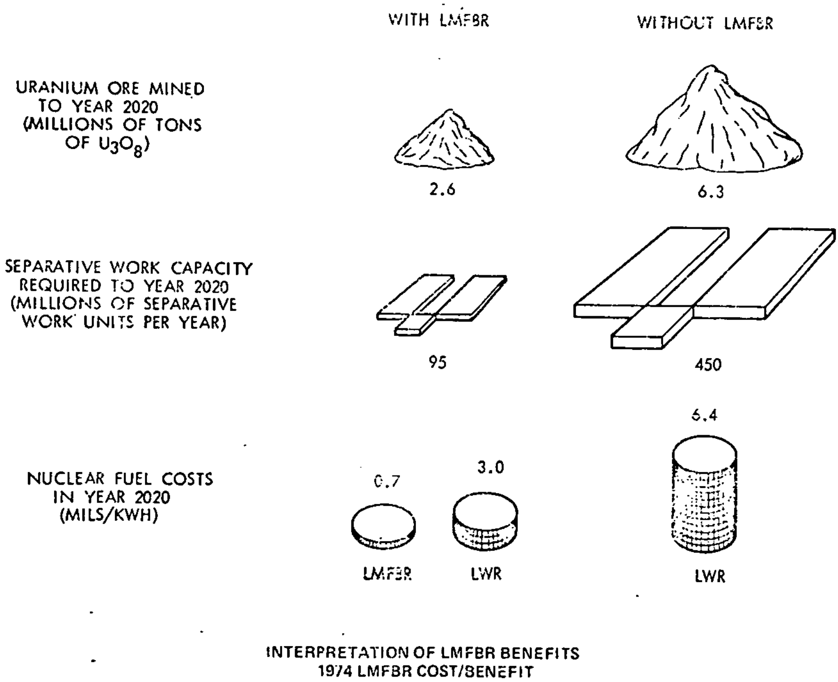

FIGURE 2

APPENDIX A

BACKGROUND INFORMATION ON VARIOUS ENERGY OPTIONS

Most of the following statements on alternate sources for producing electricity are condensed from the Proposed Final Environmental Statement (PFES) on the LMFBR Program. The PFES is currently under ERDA review and material contained therein is subject to change. Reference should be made to the final Environmental Statement when it is issued. References sehould also be made to the comprehensive energy R & D plan currently being prepared by ERDA when it is issued.

SOLAR

There are a number of proposed methods of using solar energy. These include direct utilization, such as thermal conversion, photovolatic conversion, and thermal energy collection for space conditioning, as well as indirect solar energy systems such as those based on wind and ocean thermal gradients. The solar energy reaching the surface of the United States exceeds the energy produced from conventional fuels by a factor of nearly 700. However, the portion of this energy that can be effectively utilized is limited by technical, economic, environmental, and social consideration.

The major drawback in the use of solar energy is the diffuse and periodic nature of sunlight. Considering nights, weather, seasons, atmospheric attenuation, and variations in latitude, the average rate at which solar energy reaches the surface of the U.S. is 17 w/ft^2. Although certain areas of the United States are better suited for solar conversion, large amounts of land would be required to meet present and future electrical demands through solar-to-electric conversion. For example, a 1000 MWe thermal conversion solar plant capable of operating at a 70% capacity factor would require about 10 square miles of land. Large amounts of land, especially in the Southwest, could probably be made available for this purpose, but a greater problem would be the manufacture and construction of the collection and conversion systems. The manfacture of the collectors, converters, and energy distribution equipment to cover large areas of land would require vast amounts of resources, as well as the development of an industry to supply the equipment. The efficiency of solar systems must be high if land use is to be minimized. Estimates of the efficiency of solar-to-electric conversion systems vary from a low of 1 or 2% for the combustion of photosynthetic material to a high of 30% for a thermal conversion system.

The estimated costs of solar-to-electric power systems are high; generally, exceeding $1,000 per kilowatt. In most cases, the estimates are for systems that do not incorporate sufficient energy storage capacity to provide a firm power source. Such plants could be valuable as a means of displacing the burning of fuel in conventional power plants, but would not materially change the need to build conventional power plant capacity. It is concluded, therefore, that solar-to-electric conversion systems have poor prospects for economically competing with coal, nuclear, or geothermal energy for at least several decades.

Most experts agree that the best opportunity for the application of solar energy is in the heating and cooling of buildings. The NSF/NASA solar energy panel estimated that 10 percent of the thermal energy for buildings could be supplied by solar in the year 2000 and 35 percent in 2020. This application could displace some electricity that would have been used for space heating, cooling, and water heating in buildings. Based on the NSF/NASA projections of market penetration for the solar heating and cooling of buildings, it is estimated that electricity displacement could amount to 2 percent in the year 2000, and 5 percent in 2020.

GEOTHERMAL ENERGY SOURCES

Geothermal energy may play an important role in meeting future electrical demand, especially in the western one-third of the U.S. The conversion of geothermal heat to electrical energy is less efficient than using the higher temperature and pressure steam produced in nuclear and fossil-fueled boilers, but the absence of fuel costs makes geothermal power attractive if geothermal reservoirs can be developed economically. Geothermal energy also has alternative uses, such as the production of industrial heat or the desalinization of water.

There are several types of geothermal systems. Vapor-dominated systems, such as The Geysers which produce live steam, are rare and are not entirely prototypic of future geothermal developments. Liquid-dominated reservoirs produce a hot, corrosive, liquid brine which is used to produce steam or vapor to drive a turbine. Dry, hot rock systems are the most common, but development work to utilize these resources is just beginning.

The quantity of geothermal energy below the earth's surface in the United States is vast, but there is wide disagreement as to what extent this energy may be utilized in the coming decades. The Hickel panel has estimated that 75,000 MWe could be developed by the year 2000 with a moderate research and development program and that 395,000 MWe could be developed with an accelerated research and development program. The Department of the Interior estimates in the "Final Environmental Statement for the Geothermal Leasing Program," that 75,000 MWe will be produced geothemally by the year 2000.

The Bureau of Mines has made an even lower estimate of 40,000 MWe for the year 2000. The projected geothermal capacities adopted for the PFES are those proposed in "The Nation's Energy Future." The projected capacities were 80,000 and 200,000 MWe for the years 2000 and 2020, respectively, which is 6% of the projected demand for both of these years. A large number of potential geothermal sites have been identified in the western United States. However, the technology to economically extract energy from many of the sites has not been developed. and until this is done, it will be impossible to determine how much geothermal energy can becounted as a recoverable resource.

The major potential environmental impacts of the use of geothermal energy are in the general areas of surface and groundwater quality impairment as a result of fluid disposal, air emissions such as hydrogen sulfide, noise from drilling and steam venting during operation, uncontrolled blowouts, aesthetic impact, land subsidence from fluid withdrawal or reinjection, land use, and damage to vegetation and wildlife. The environmental impact of geothermal generation is largely restricted to the generating site and its immediate surroundings—a contrast with fossil- or nuclear-fueled generation, for which impacts occur at several locations (mines, processing plants, disposal sites). The different types of geothermal systems present different environmental impacts. Because of the relatively pure fluid in the vapor-dominated reservoirs, the fluid-disposal problem is relatively small compared with that of the hot-brine systems, whose high salinity represents a potentially serious environmental impact. The environmental impact of hot-rock utilization has not yet been thoroughly evaluated and cannot now be fully defined.

ORGANIC WASTES

The economics of using organic wastes for power generation have significantly improved in the past few years because of: (1) the rise in fossil fuel prices; and (2) the increasingly difficult problem of waste disposal. The limitation on the use of organic wastes for power generation is that there is simply an insufficient quantity of collectable material to make a large impact on energy supply. The Bureau of Mines has estimated that 136.3 million tons of potentially collectable organic wastes were generated in 1971. If all these wastes had been converted to electricity at the national average conversion efficiency of 32%, the power production for 1971 would have been 205 billion KWhr or nearly 13% of the national demand. The EPA has estimated that urban waste collection will increase at a rate of 3.4% per year until 1980.

If the quantity of collectable wastes would increase by 2.4% per year until the year 2000, and if it were possible to utilize all collectable wastes for power production, wastes could produce 550 billion KWhr of power, or about 5% of the demand in the year 2000. After the year 2000, it might be expected that conservation measures would stabilize the amount of waste packaging materials and that, because of worldwide pressures on food, more grain would be consumed directly, thus reducing animal wastes. If collectable wastes held steady at the year 2000 level, they could supply only 2% of the year 2020 power demand. Complete utilization of organic wastes does not necessarily mean total conversion to power, because they could also be converted into synthetic petroleum.

CONTROLLED THERMONUCLEAR FUSION

Controlled thermonuclear fusion offers the possibility of virtually unlimited energy resources, because the deuterium contained in the oceans would serve as its fuel. Fusion reactors could also be fueled by breeding tritium from lithium, but even using this more limited resource, fusion could meet projected electricity demand for centuries.

A fusion reaction occurs in a fully ionized gas called a plasma. The central problem at present is to confine a reacting fusion plasma at conditions of density, temperature, and confinement time sufficient to produce a self-sustaining fusion chain reaction. A controlled self-sustaining fusion reaction has yet to be achieved, but ERDA is supporting programs that are exploring two separate methods to reach this goal. Magnetic confinement techniques to produce a suitable plasma have been pursued since 1951, and currently, three different magnetic confinement concepts are being studied. A new approach, using a pulsed laser to heat and compress a plasma to the necessary conditions, has been pursued since 1962. Both concepts may reach the important milestone of a controlled self-sustaining reaction by 1980. If this milestone is met, it may be possible to build a demonstration net-energy-producing fusion reactor in the 1990's and to achieve commercial introduction of a fusion reactor in the next century. Although scientific feasibility of a practical, controlled fusion system has not been demonstrated, the estimate from "The Nation's Energy Future" that 8% of the year 2020 electrical demand could be met with fusion power has been adopted as the potential contribution of fusion for the PFES.

COST COMPARISONS

The following table indicates the amount of electric energy projected in the years 2000 and 2020 for non-fission electric energy sources as given in the cost-benefit analysis section of the PFES. The total base electric demand projections used in the PFES was 10.6 trillion KWhrs in the year 2000 and 27.6 trillion KWhrs in year 2020.

[In trillion kilowatt-hours]

Energy source	Year 2000	Year 2000
Solar	0.21	1.40
Geothermal	.63	1.60
Organic wastes	.54	.54
Fusion	0	2.21
Total	1.38	5.75

Subsequent to the PFES, in response to suggestions by some of the commentors on the Draft Environmental Statement and the PFES, benefit calculations similar to those for the PFES cost-benefit analysis were done that included alternate electrical energy sources. The capital and operating costs for the alternatives were selected from the current literature or crudely estimated if not available in the literature. This analysis is considered to have a very wide error band due to the large uncertainties associated with the costs of the alternatives. Not until there are available detailed designs based on developed technologies to estimate the costs for the alternatives can a cost-benefit study with a reasonable error band be made. Figure 1 indicates the costs associated with each of the plant types used in the benefit analysis where the alternative power plants were included. Following are some details on how the costs were determined for the alternative plant types.

UNIT POWER COST COMPARISON: NEW TECHNOLOGY VERSUS CONVENTIONAL POWER PLANTS

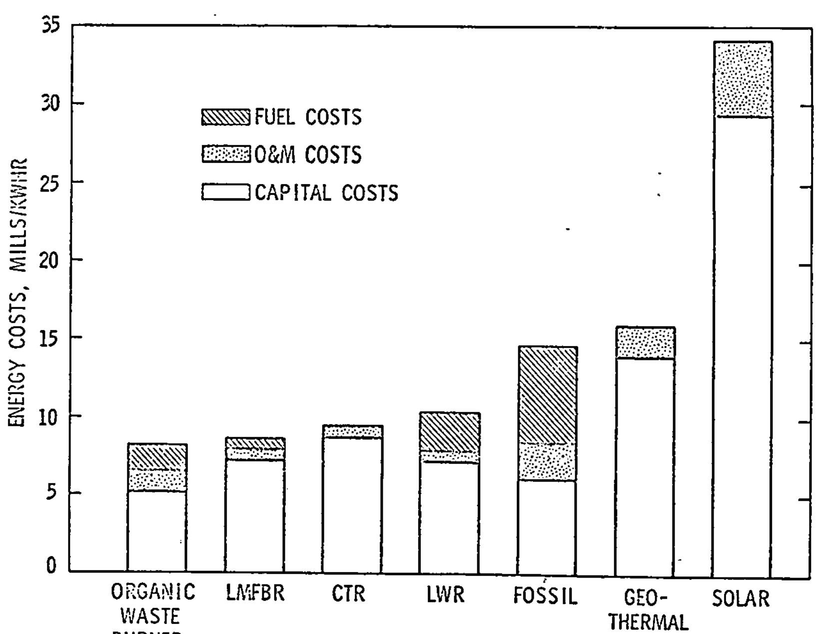

FIGURE 1

GEOTHERMAL PLANTS

Capital and operating costs of the geothermal plants were based on estimates in the Project Independence Blueprint. A unit capital cost of $712/KWe in 1974 dollars was assumed; this is the mid-range value of $562–$862/KWe given in the Blueprint, and assumes the major source of geothermal energy derives from hydrothermal, liquid-dominated reservoirs. No scaling of unit capital costs was assumed between 1300 MWe and 2000 MWe ratings. Cost scaling does not appear appropriate for these plants because of probable costs of steam collection systems for large units.

Operating costs were set at 2 mills/KWhr, based again on information from the Project Independence Blueprint. Based on plants operating at 100% capacity factor, an arbitrary division of ⅔ fixed costs, ⅓ variable costs was assumed.

SOLAR ENERGY

Capital costs of the solar conversion plants were taken to be $300 per peak kilowatt, or $1500 per average kilowatt, based on values in the Subpanel IX report for "Our Nation's Energy Future." This cost was assumed to include sufficient storage to permit base-load operation, although the Subpanel IX report notes that the $1500/KW cost excludes storage costs as well as other plant equipment and construction costs.

Annual operating and maintenance costs were taken as 2% of the capital investment. These costs agree closely with the 3 mills/KWh estimated by EPRI[1] as O&M costs for solar plants. O&M costs were arbitrarily divided as ⅚ fixed costs, ⅙ variable costs (based on 100% plant factor).

ORGANIC WASTE BURNERS

Organic waste-burning plants were assumed to have capital and operating costs comparable to those of coal-burning power plant with no desulfurization equipment. Capital costs were estimated at $291/KWe for a 1300 MWe plant, and $265/KWe for a 2000 MWe plant. Fixed O&M costs, for 1300 and 2000 MWe plants, were estimated at $6.2 and $8.3 million per year and variable O&M costs (100% plant factor) were, respectively, $10 and $13.4 million per year. The capital and O&M costs for these plants were furnished by Holifield National Laboratory, using the same methods for plant capital and operating costs provided in PFES.

Organic wastes used as fuel in these plants was assumed to be free of charge. However, an addition of 10% oil as supplemental fuel was assumed to be needed to maintain good combustion. At $9/bbl and an assumed heat rate of 10,000 Btu/KWh, this resulted in a net fuel cost of 1.5 mills/KWh.

FUSION PLANTS

No basis exists for estimating the capital and operating cost of a CTR plant. Therefore, plants of this type were assumed to produce power at a cost equivalent to the average power cost of nuclear plants, over the span from the years 2000 to 2020, calculated for Case 3 (the base LMFBR case) of the PFES cost-benefit study. Capital and operating costs were chosen consistent with those power costs. Net fuel costs for CTR plants were assumed to be zero.

Chairman HUMPHREY. We have a panel now of Mr. Nader, Mr. Simpson, Mr. Cochran, and Mr. Stauffer.

Let me say that this review we are conducting by the Joint Economic Committee will, I believe, significantly add to congressional understanding of this mamouth program.

Under the able leadership of Chairman John Pastore, I know that the Joint Committee on Atomic Energy will be giving this program its most careful and objective scrutiny. I have met with Chairman Pastore and have assured him of our complete and full cooperation in any

[1] D. F. Spencer, "Solar Energy: A View from an Electric Utility Standpoint," EPRI: Preprint No. 104, American Power Conference, April 1975.

way possible with the Joint Atomic Energy Committee which has legislative responsibility in this area as it continues its critically important work with regard to this program.

I make this statement because the Joint Economic Committee is a consulting and advisory committee to legislative committees. We have no legislative function as such and what we seek to do here is explore certain areas that add relevance to the economic implications of any proposal and then transmit our findings and observations, our review, to the appropriate bodies in the Congress.

Now, we have brief statements, I believe, from our witnesses, our panel members. I am going to ask Mr. Nader to lead off, and Mr. Nader will be followed by others that we will call.

STATEMENT OF RALPH NADER, REPRESENTATING PUBLIC CITIZENS GROUPS

Mr. NADER. Thank you, Mr. Chairman and members of the Joint Economic Committee.

The plutonium breeder reactor, like the SST was scheduled to become on a smaller scale, is a Government-financed moloch, plagued by catastrophic dangers, massive cost overruns, and questionable economic value, which the Government technocrats are building for the private utilities. These hearings are an encouraging sign that many Members of Congress recognize nuclear power is a policy matter that cannot be left to the Joint Committee on Atomic Energy.

I would like to make a few preliminary points which perhaps the committee and the staff would want to follow up by getting additional information.

A few years ago when I was discussing the breeder proposal with a number of scientists, there was vigorous disagreement about what kind of design the breeder should follow. At the present time the type of design that has been chosen is not uniformly supported by even those people who promote the breeder.

Without characterizing his particular position any further, it is enough to say that Mr. Albert Weinberg sees the molten salt breeder as a desirably alternative design. Of course, the costs of the whole breeder program on just one design is so massive it is not likely that alternative designs will be pursued coterminously. This raises the question as to the true judgments of various scientists in this area concerning which is the best design to pursue.

That is a narrow issue but it is one worth projecting because if the wrong design was selected, much of what is being discussed by way of breeder potential at these hearings would be quite academic because the breeder potential, such as it is, in the view of its advocates, would not be met. They are putting all of their breeder eggs in one design basket, in effect.

The second point that I would like to make is that there is no question in my mind that this program is going to be carried by the American taxpayer far beyond its development stage. I say this because not only of the reluctance and incapability of the utilities to handle this program, but the kind of experience which light-water reactors are already recording.

In the New York Times just a few days ago, I might emphasize, Westinghouse Corp. was reported as suggesting that the U.S. Government buy the offshore nuclear power plants, that it, with a joint venture with another company, were going to produce out of Jacksonville, Fla., that the U.S. Government buy these plants and then lease them back to the utilities.

I think you are going to see the Government saddled with what might be called lemon socialism; that is, you sell off to the Government what projects you don't want to carry in the future. Con Edison, for example, sold off to New York State one of its nuclear plants under construction. The question of the pattern of selling to the Government and letting the Government bear the risks needs to be probed.

Chairman HUMPHREY. In other words, you socialize the losers and privatise the winners?

Mr. NADER. Exactly. If they are willing to do that with the offshore nuclear reactor, that is like saying they are most definitely pursuing this process with a much more complex and weighty and risky breeder technology.

The third point I would like to make relates to employment and the breeder. One of the most outmoded fallacies in economic thought is that there is inevitable connection between economic growth and energy use. I think we are now seeing that not only is this connection not inevitable, but that it may be disastrous to pursue it with such single-minded dedication.

There are other countries in the world who have good standards of living whose per capita consumption of energy is dramatically less than our. We consume almost 2½ times per capita more than the West Germans, almost three times more than the French. It is quite well known that energy intensiveness does not bring a higher standard of living per se. It is not as well known that energy intensiveness may actually reduce employment. The petrochemical industry is an example of that, I believe.

Chairman HUMPHREY. Would you repeat those figures that you gave us there on the energy use?

Mr. NADER. Per capita consumption in this country is almost 2½ times that of Western Germany, about three times that of France, more than twice that of England, and part of it is explainable by a more thrifty tradition in using energy, part of it is explainable by more fuel-efficient cars, et cetera.

Chairman HUMPHREY. Yet, the per capita income of the citizens in West Germany, based upon the value of purchasing power of the relative currencies, is higher today than ours.

Mr. NADER. That is certainly true in Sweden, yet in Sweden our per capita energy consumption is again about double that of the Swedes.

In the Ford Foundation report—"A Time To Choose"—where they develop a zero energy-growth scenario, they make the statement, "Adaptation to less energy incentive requirements would not reduce employment, it would, in fact, create greater need for employment." We say only 6 percent of the people in this country are engaged in farming and that shows how efficient it is, we also have to consider that since farming is so energy-intensive, there is a large backup pool for farming that could be counted as employed in farming, so we are drawing a circle around it and concluding erroneously in that matter.

Further, the Ford Foundation states energy and economic growth rates can be safely uncoupled. I would say if by energy growth we mean highly dangerous nuclear fission technology, that adds an entirely different dimension to the risk to the economy.

If there are major catastrophes, if major areas are contaminated with cancer-producing radioactivity and hundreds of thousands of people are injured and tens of thousands are dead, that is going to affect our economy, in addition to the massive tragedy. It may not affect our economic growth rate because we will have to have hundreds of thousands of people trying to deal with the disaster, but this is, once again, how narrow our perspective is because we still do not realize that economic growth does not mean economic well-being.

Your gross national product indicators are so gross that a doubling and tripling of the number of people that die on our highways each year would be a contribution to the gross national product by virtue of the fact that they generate demands for various goods and services. That is the kind of economic growth we can do without.

There is the additional point which Mr. Cochran will develop, of fostering a plutonium economy. If someone were to say "Would you back an energy system in this country that trafficked in botulism? I don't think anybody would say, "Yes." The enormous carcinogenic effects raise a similar possibility. We cannot afford to jeopardize future generations and every time we build a nuclear powerplant, whether it is breeder or light-water reactor or any other design that results in plutonium or deals with plutonium, we are developing a national security problem in the United States.

There is no better proof of this than the perceived levels of safeguards which utilities want to take if they are to be prudent in guarding these plants. The Virginia Electric Co., VEPCO for short, requested of the Virginia Legislature, a few months ago, the authority to provide its private police with the right to arrest anybody in the State of Virginia and have access to confidential citizen files. They justified this on the basis of Federal Government security precautions. The Government denied that such extraordinary measures had to be taken, but the point is these utilities can not only justify high incursions in security and in civil liberties because they are dealing in potential catastrophic technology, but they can attempt to put the dollar cost on the taxpayer.

Whenever we talk about the breeder's cost to the consumer, we have to get past the numerical shenanigans that the utilities are propagating on the public. It is the cost of waste disposal, the cost of decommissioning the plants after 30 or 40 years, the cost of transportation, the cost of insurance subsidy, the cost of fuel reprocessing, the cost of safeguarding.

Massive private and public national policies are going to be required to deal with thousands of vehicles and hundreds of plants and associated technologies containing deadly radioactive materials.

I think it would be very helpful if this committee would ask specifically of the Nuclear Regulatory Commission, for their studies on the costs of decommissioning these plants, on the costs of safeguards and who are going to bear these costs between private utilities, manufacturers, and fabricators, and Uncle Sam, via the U.S. taxpayer.

Chairman HUMPHREY. Mr. Nader, we will ask ERDA for their evaluation of these costs. I think that is relevant material and it ought to be included in the record.

Mr. NADER. Also the Nuclear Regulatory Commission. It is not only the guards up front, for every guard up front there is a vast clerical background that is part of the security safeguards industry.

By the way, security guards we have talked to almost throw up their hands in utter despair at the assertions that these plants are now adequately guarded.

The examples which will someday be presented to a congressional committee are horrendous. Hundreds of keys distributed without record as to who has them, for example.

I would note that Mr. Thorne said this morning that if utilities don't think the breeder is commercially attractive, the Government won't proceed with it, is that a correct reflection of what he said?

[The following letter, with enclosures, was subsequently supplied for the record:]

U.S. NUCLEAR REGULATORY COMMISSION,
Washington, D.C., November 17, 1975.

Hon. HUBERT H. HUMPHREY,
Chairman, Joint Economic Committee,
Congress of the United States.

DEAR CHAIRMAN HUMPHREY: This is in response to your September 3, 1975, letter requesting information regarding the costs involved in decommissioning nuclear plants and the costs required for nuclear safeguards and for nuclear waste disposal.

Available cost data for each of these categories has been summarized in tabular form in Enclosure 1. These costs have been estimated for a mature, light water reactor industry utilizing power reactors of 1,000 MWe generating capacity and employing plutonium recycle.[1]

As I'm sure you appreciate, the cost data requested cannot be determined precisely. In some cases only rough estimates could be provided. The enclosures identify the various assumptions which were the basis for the cost estimates. Decommissioning costs for fuel cycle facilities are not currently available. We anticipate having initial cost estimates in January 1976. We will provide you with a summary of these when they become available if you are interested.

Enclosure 2 provides a brief description of the major decommissioning alternatives for nuclear power plants. Also included are specific examples of costs incurred in decommissioning low-power facilities employing each alternative and, in addition, an example of the manner in which these data are utilized in estimating the cost of decommissioning the larger, more modern nuclear power plants.

Please do not hesitate to advise if I can be of further assistance in this matter.

Sincerely,

WILLIAM A. ANDERS.

Enclosures.

ENCLOSURE 1

ESTIMATED COSTS FOR SAFEGUARDS, WASTE MANAGEMENT AND DECOMMISSIONING

(Cost per plant in 1974–75 dollars)

Nuclear powerplants

Estimated costs for decommissioning and for the waste management and safeguards activities involved in the operation of a typical 1,000 MWe light water power reactor are presented in Table 1. The rationale for inclusion of high and low decommissioning cost estimates is discussed below.

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[1] The use of mixed oxide fuels in light water reactors is the subject of a Generic Environmental Impact Statement currently under preparation by the U.S. Nuclear Regulatory Commission. This statement will provide a comprehensive cost-benefit analysis that includes consideration of various safeguards alternatives. Should the cost-benefit analysis favor use of mixed oxide fuel and identify more stringent safeguards requirements, the safeguards cost estimates in Enclosure 1 would be increased accordingly.

TABLE 1.—1,000 MWe LWR POWER REACTOR

[Estimated costs in millions of dollars]

	Decommissioning [1]		Waste management [2]		Safeguards [3]	
	Capital	Ann5al	Capital	Annual	Capital	Annual
Low	1	0.1	25	3	0.5	0.25
High	70	0				

[1] Cost estimates are based upon extrapolation of costs incurred in decommissioning low-power units as described in enclosure 2.

[2] Indicated costs are based upon experience to date. On the average, capital costs approximate 5 percent of total capital cost of a typical LWR installation.

[3] Estimated costs are based upon experience to date and are as indicated in ch. VIII of WASH 1327 (generic environmental statement on mixed oxide fuel).

Licensees may elect one of three basic alternatives in affecting the decommissioning of a nuclear power plant. These alternatives, listed in order of increasing cost, consist of: (a)—mothballing, (b)—entombment, or (c)—dismantling. Current cost estimates for decommissioning a typical 1,000 MWe light water power reactor range from a low, involving an initial $1 million capital expenditure plus an annual maintenance cost of $100,000 for mothballing to a high involving a $70 million capital cost for dismantling and complete site restoration with no subsequent costs involved. Of course, it should be realized that the decommissioning costs indicated above are estimates for future expenses at the time of facility decommissioning. Expressed in present values, these estimated costs would be substantially reduced.

Experience with actual decommissioning costs for nuclear facilities has been quite limited. As a consequence, cost estimates for reactor decommissioning are subject to a considerable range of uncertainty. Enclosure 2 provides examples of prior experience in decommissioning nuclear power installations together with a brief description of available decommissioning alternatives and examples of the manner in which decommissioning costs have been estimated.

It appears likely that the majority of LWR licensees will, at the appropriate time, elect the mothballing alternative due to the lower costs involved. To date, all but one of the eleven licensed power reactors or test reactors either decommissioned or now in the process of decommissioning have elected to employ the mothballing alternative.

Nuclear fuel cycle plants

Experience to date in the decontamination and/or decommissioning facilities employing typical nuclear fuel cycle operations has been inadequate to permit a systematic determination of the costs involved in decommissioning typical production scale fuel cycle plants. A comprehensive study was initiated in mid-1974 with the specific objective of evaluating the probable costs for decommissioning fuel cycle plants to various levels of environmental restoration. This study is being conducted under a contract administered by the NRC Office of Standards Development and is expected to continue through the end of fiscal year 1977. Initial decommissioning cost estimates for fuel cycle facilities are anticipated by January, 1976.

As a consequence, only those cost estimates applicable to the waste management and safeguards aspects of LWR fuel cycle operations are presented in Table 2.

TABLE 2.—LWR NUCLEAR FUEL CYCLE PLANTS

[Estimated costs in millions of 1974-75 dollars]

Fuel cycle plant type	Waste management[1] Capital	Waste management[1] Annual	Safeguards[2] Capital	Safeguards[2] Annual
Uranium mill	3	0.1		
UF_6 conversion plant	5	1.5		
Enrichment plant	30	2.0	(3)	(3)
Uranium fuel fab plant	3	1.0	1	1
Mixed oxide fuel fab plant	3	3.0	3	2
Fuel reprocessing plant	50	12.0	3	2
Waste solidification (glass)	75	15.0		
Waste isolation facility	125	15.0		

[1] Waste management cost estimates for fuel reprocessing plants, waste solidification and waste isolation facility are based upon ERDA budgetary estimates and available industry data derived from limited activity in these areas. Indicated costs for mixed oxide fuel fabrication plants represent preliminary cost estimates of commercial organizations in the nuclear fuel cycle industry. Estimated costs for other facilities are based upon a combination of current estimates of the nuclear industry and extrapolation of available data representing prior activity in these areas.

[2] Costs involved in satisfying existing uranium accountability requirements were determined from experience to date. Additional costs necessary to satisfy the physical security and material accountability requirements for plutonium were added to the above uranium costs to obtain the indicated total cost estimates. Cost elements comprising the overall estimate of safeguards costs applicable to the above facilities are discussed in ch. VIII of WASH 1327 (generic environmental statement of mixed oxide fuel).

[3] Safeguards costs for enrichment plants have not yet been determined by the NRC since all enriching to date has been performed in Government owned, license exempt facilities.

Nuclear safeguards

Safeguards costs indicated in Tables 1 and 2 are based upon current estimates of the costs involved in fulfilling existing NRC safeguards requirements. It should be noted, however, that the requirements are evolutionary in nature, and future modifications will be made in response to changing social, political, and technological conditions.

ENCLOSURE 2

NUCLEAR POWER REACTOR DECOMMISSIONING

The major decommissioning alternatives for nuclear power plants are mothballing, entombment and dismantling. These alternatives can be described as follows:

1. *Mothballing.*—Mothballing is the process of placing a nuclear power plant in protective storage after removing all fuel, radioactive fluids and radioactive waste from the site.
2. *Entombment.*—Entombment consists of sealing the remaining radioactive components in a concrete and/or steel structure after removing all reactor fuel, radioactive fluids and radioactive waste from the site.
3. *Dismantling.*—Dismantling consists of removing all fuel, radioactive fluids, radioactive waste and radioactive structures from the site.

Specific examples of costs which have been incurred in the decommissioning of nuclear power plants are given below with respect to each alternative method:

1. *Mothballing Costs.*—The Saxton nuclear power plant (28 megawatts thermal) in Saxton, Pennsylvania, was placed in a protective storage status (mothballed) in 1973 for approximately $500,000. The cost of continued security and protective maintenance of the remaining structures of the Saxton facility is approximately $10,000 per year.

The Peach Bottom Unit No. 1 power reactor (115 megawatts thermal) in York County, Pennsylvania, is now being prepared for protective storage. The costs for the preparation of Peach Bottom Unit 1 for protective storage and the continued security and protective maintenance are estimated to be approximately the same as the costs incurred at the Saxton facility.

2. *Entombment Costs.*—Entombment of the Hallam Nuclear Power Facility (254 megawatts thermal) at Hallam, Nebraska was accomplished in 1968 at a cost of approximately $3,000,000.

3. *Dismantling Costs.*—Dismantling of the Elk River Power Plant (58.2 megawatts thermal) at Elk River, Minnesota was accomplished in 1973 at a cost of approximately $6,000,000.

The costs for decommissioning the larger modern nuclear power plants are estimated to be on the order of 6 to 10 times the costs mentioned above. For example, the estimated cost of mothballing Indian Point Unit No. 3 (3,216 megawatts thermal) in Westchester County, New York is $3,000,000. (1973 dollars and technology). Subsequent costs for security and protective maintenance are estimated at $300,000 per year (Indian Point Unit No. 3 Final Environmental Statement, February 1975).

The Atomic Industrial Forum, Inc. has initiated a study of the costs of decommissioning of nuclear power plants. This study is scheduled for completion by November 1975.

Chairman HUMPHREY. I think what he said was if the private utilities did not come in that the Government would proceed with it—would take on the full burden.

Mr. NADER. Yes, of development. I am talking about the commercial attractiveness of operating the breeder.

Mr. THORNE. What I said was, in looking at the near commercial breeder reactor, if it appeared to ERDA that the utilities did not find that to be a commercially attractive reactor concept, the Government would probably not go forward with any plans to build that reactor.

I also said, earlier in our planning, we would assume the Government would support most of the near commercial breeder reactor.

Mr. NADER. That is an important statement, because the question arises, if the utilities did not think it is commercially attractive and the taxpayer is into it for $7 or $8 billion or more, are you going to be stampeded into basically accepting a sale and lease-back situation and a multiple-subsidy situation? I think that has to be clarified now rather than later. I am fully aware of the ingenious minds of corporate lawyers and the way they can develop these arrangements, and I am also aware of how Congress is reluctant to throw away a program after it has sunk so much taxpayer money into it. It becomes a matter of face-saving, a matter of not wanting to cut their losses.

I think that should be clear as to what the Government is prepared to do in the subsidy plus Government purchase and lease-back situations.

Chairman HUMPHREY. Again, we will present those scenarios to the appropriate authorities and ask for their plans. I think that is fair, particularly with our experience with the SST. Congress had to make that decision, as you know, it was a very difficult one.

Mr. NADER. The other question, when Congress is expected to deal with technology that will not go on line until the 1990's, is how do you predict, how do you base policy on a technology that has no experience by definition because it is not onstream, except for the Michigan breeder, which is the Fermi reactor, I believe, that had a rather interesting experience, it is now shut down forever after a near miss, in terms of its own catastrophe, since 1966. How does Congress do that? One is to proceed by legislating faith. You just have confidence in utilities and manufacturers and Oak Ridge National Laboratory and the Government.

Another way is to proceed by basing your considerations on experience already occurring with existing reactors.

As I point out in my testimony, which I shall not read in detail——

Chairman HUMPHREY. We shall include it in the hearing record.

Mr. NADER. The experience with present reactors is not good at all. It is replete with serious design problems at the manufacturers' and vendors' level, serious questions by even advocates of nuclear power as to whether the utilities have the managerial competence to handle such awesome technology. There are serious disagreements between advocates of nuclear power about whether they should be built underground or remain in their overground site.

Mr. Weinberg, who is for nuclear power, does not believe the utilities have the capability of securing the requisite safeguards to deal with sabotage, thefts, and other breakdowns, natural or man made, in the program. That is why he is recommending nuclear parks under a scientific, technocratic priesthood to be developed.

I think it is also important to note how sloppy plutonium has been handled. A scientific magazine is pertinent to this point which I mention in my testimony as well as internal and external government reports.

The GAO is doing good work in this area, dealing with safeguards, transportation of radioactive material risks, and the like, which can be suggested for further elaboration.

It is also, I think, important to look at our overseas responsibilities here. Clearly, if we go ahead with nuclear power in this country we are going to expand the exporting of nuclear reactors of all designs abroad. This is now being done again with the taxpayer input via the Import-Export Bank pushing Westinghouse and General Electric reactors onto undeveloped countries without a scintilla of the managerial infrastructures required to even give these people a chance as to whether these are going to be carefully operated near their population areas. The idea of our country safeguarding these plants is one of insuperably challenging proportions. The idea of South Korea and Formosa and Brazil and Argentina and other countries doing the same, is preposterous, not to mention the possibilities of diverting these materials to weaponry purposes.

This is also related to the contracts which we are developing overseas which may develop a two-way process. We sell them the reactors, they return the radioactive garbage to the United States. This also must be inquired into, some of it the committee can get quite easily from the Government, I think some pressure about the kind of arrangements that are going to be developed with these foreign recipients need to be brought to the surface.

It was mentioned earlier this morning one of the attractivenesses of the breeder is the fact that it breeds its own fuel and this is going to be cost-effectiveness. I suggest that those enthusiasts for the breeder learn a little more about the Exxon-OPEC cartel, and I say the Exxon-OPEC cartel rather than the OPEC-Exxon cartel because the main vested interest now in the high imported oil prices is the domestic or multinational U.S. oil companies. There is not a chance that the United States will send troops to the Middle East to keep the price of oil from increasing, there is more of a chance that we would send troops there to keep the price of oil from dramatically decreasing. That is the main disturbance in the oil industry today—that the Middle East nations will drop the price and wreak havoc in terms of the price structure for fossil fuels as well as alternative fuels that the oil companies are into.

No one will deny that the oil companies have benefited greatly, here and abroad, with their sales and their energy values by high OPEC oil cost and also in terms of what they are beginning to succeed to do in Congress, that is, convincing more and more Members of Congress that all lesser expensive forms of energy must be brought up to the highest form of OPEC price and that is going to have inflationary and other consequences in this country.

I would draw the committee's attention to the need to ask these companies to divulge their contractual relationships which articulate in reality this kind of upward push strategy. It is now being done in natural gas and coal and elsewhere on the pretense that it will encourage production. But have Federal coal leases encouraged production? These are held in abeyance without any production. The same is true for offshore leases off the Louisiana coast.

In particular, I would advise the committe to ask for all contractual relationships between the oil company and the Pacific Gas and Lighting Co. which buys the geothermal energy to provide San Francisco with over one-third of its electricity. In that contract there is a provision linking the price of geothermal to the escalating price of oil and gas. So the price of geothermal is going up to Pacific Gas and the consumers of electricity in San Francisco, having nothing to do with the increased cost of producing geothermal, but having everything to do with the increased cost of oil and gas which are in turn tied into the price of the Exxon-OPEC cartel level.

When it comes to the breeder, what is to prevent this same kind of thing from happening, with the utilities having that same incentive to accept that kind of Btu equivalent in order to make more money and I think we better look at that very seriously.

It is a cruel burden to place on Congress to ask the Congress to support a program whose empirical fallibility will not be apparent, in its operational effects, until the 1990's and prevent the Congress from access to the full data and the full universe of concern from energy conservation potential onward, in order to make that decision. I think it is a very cruel burden and I hope the Congress does not succumb to the Lorelei of unassessed technology.

Often, because past technology has suceeded in part, there is a feeling that future technology will succeed. But with the SST rejection in Congress a new watershed criticism is developing and we have to look very carefully as to how technology can destroy economy, can breed national security problems, can impair our civil liberties, how technology can become its own economic moloch absorbing more and more economic costs in a never-ending refusal to turn around and change the system.

The most recent evidence of the kind of commitment that the Government has required from utilities in the breeder program, Mr. Chairman, can be seen in the GAO report of April 4, 1975. GAO reports are getting better and better and more frequent and by that definition they tend to get less coverage because there are so many of them pouring out of the office. Furthermore, the style is so severe that sometimes reporters don't really know what the GAO is coming up with, even though, when you read between the lines, it is a pretty serious indictment.

Regarding the report of April 4, 1975, on the contractual arrangements between ERDA and the private utility participants in the Clinch River demonstration breeder reactor (CRBR). The purpose of the CRBR is to demonstrate the viability of the plutonium breeder concept. The proposed contractual arrangements permit the utilities to pull out of the CRBR project if a basic design change is ordered. The GAO report notes that a basic design change that may be required by the Nuclear Regulatory Commission is a safety device known as a core catcher. One of the purposes of a core catcher, which a number of independent scientists believe is an essential safety feature if breeder reactors are built at all, is to stop a secondary nuclear explosion from occurring after an accident occurs in the reactor. The GAO report notes that: "There are strong indications that the utility participants are opposed to including a core catcher in the CRBR design." Of course, if a core catcher is required and as a result the utilities pull out of the project, the viability of the plutonium breeder concept as a source of power for utility companies will not be demonstrated. And if they are not even willing to sink in a pittance, that is what their investment is, a pittance, about a quarter of a billion dollars, then will this still be pushed as a commercially attractive program or will it be a set up for Government ownership and subsidy with the corporations raking the cream of the profits.

The purpose of the breeder demonstration project is to show that the breeder program can be commercially viable; that is, that the utilities are willing to invest in plutonium breeders as a major source of electric power. They are not even being asked to invest in insurance premiums, mind you.

This is even going deeper. Will they invest their money in the technology itself, which is covered by the limited liability clause in the Price-Anderson Act?

The nuclear industry is the only industry that has been given limited liability for damage done to people outside of the plant.

If the utilities pull out as a result of NRC's requirement of a core catcher, the entire rationale for the Clinch River program will be negated.

The effect of this contract provision, which permits the utilities to pull out of the project if they do not agree with safety requirements, will be to put pressure on the Nuclear Regulatory Commission not to require the core catcher. As the GAO report states: "The possible consequences of a decision by the Nuclear Regulatory Commission that could make a core catcher necessary could place tremendous pressure on this regulatory agency in arriving at a decision."

I would like to conclude on this note.

Chairman HUMPHREY. What about coal gasification?

Mr. NADER. Yes. I think we ought to pay attention to coal gasification. That is taking the methane out of the coal bed prior to mining, to reduce the hazard to mining, and piping it to market could be a new and significant source of energy. Right now it is blown away because it is considered a fire hazard. I would address your attention to this energy source.

The Bureau of Mines are now saying they estimate 225 trillion cubic feet of methane which is equivalent to 10 years' consumption of natural gas in this country. They have a pilot mine project now which is degasifying methane and sending it to market.

It is important here because in a kind of tragic way the breeder may not only be the wrong way to go, which we obviously believe it is, but it may deny the development of alternative energy sources that are the right way to go, and not just for a few decades.

Supporters of nuclear power have also doubted the wisdom of the present breeder program. W. Kenneth Davis, Bechtel Corp. executive, in his dissent to the report of the Cornell Workshops on "Major Issues of Our National Energy Research and Development Program" stated:

The priorities and expenditures for the present LMFBR program need to be reexamined in light of competing needs, including such things as coal conversion R. & D. and the probability of the present FBR program achieving a useful goal in the time required.

Specifically, in regard to the Clinch River Breeder Reactor, for which ERDA is seeking $181 million in order to move it into a construction phase, the November 22 draft by the Cornell Workshop stated, "A reactor of such low performance is not a useful reactor at all." Congress cannot responsibly appropriate huge sums for R. & D. programs on which the scientific community is so deeply divided.

Now, as a lawyer, Mr. Chairman, I am appalled by the legal malpractice in our Federal Government in developing its contracts with private industry in this area. If a private attorney for a client prepared a contract similar to the contract prepared under the breeder program between the Government and utilities, the client could sue this lawyer for legal malpractice. I think we ought to begin developing the principle of legal malpractice by government attorneys whose client is at least the citizens of this country and whose client may be the White House. But this level of legal sophistry is outrageous. It should be focused on the lawyers, not just the agency, but the lawyers who are responsible for this hoked-up type of contract which can be scrapped so easily by the utilities, quite apart from the minimum requirements that the utilities were impelled to contribute in the first place to the breeder program.

Thank you.

Chairman HUMPHREY. I thank you very much, Mr. Nader, for your thoughtful, provocative, and useful information and testimony. Your prepared statement will be printed in the hearing record.

[The prepared statement of Mr. Nader follows:]

PREPARED STATEMENT OF RALPH NADER

Mr. Chairman, members of the Committee, the plutonium breeder reactor, like the SST was scheduled to become on a smaller scale, is a government-financed moloch, plagued by catastrophic dangers, massive cost overruns, and questionable economic value, which the government technocrats are building for the private utilities. These hearings are an encouraging sign that many members of Congress recognize nuclear power is a policy matter that cannot be left to the Joint Committee on Atomic Energy.

It is not possible to discuss the plutonium breeder outside the context of our entire nuclear power reactor program. Its purpose is to insure the continued availability of the nuclear power option. During a time when increasing numbers of Americans are rejecting the risks of nuclear power, or reluctantly accepting the risks under the mistaken assumption that there is no option but nuclear power, the Energy Research and Development Administration (ERDA) has made a huge commitment—approximately one-third—of our civilian energy research and development funds to the plutonium breeder. This step, by taking crucial funds away from development of alternate sources, insures that our nation will have no option *but* nuclear power, whatever the risks.

The reason increasing numbers of Americans are rejecting nuclear power as a major source of electricity is that, in spite of twenty years of massive taxpayer funding, nuclear power has not proved itself safe or reliable.

For example, the 1973 internal Atomic Energy Commission (AEC) Task Force[1] report concluded that reactor safety was an "unanswered question." That question remains unanswered. The adequacy of the Emergency Core Cooling System (ECCS) has never been demonstrated in full scale tests. The ECCS failed 6 out of 6 semi-scale tests at the Idaho test facility. At least one expert within the Nuclear Regulatory Commission's Advisory Committee on Reactor Safeguards admits that, in spite of the AEC/Rasmussen report, the adequacy of this key safety system has not been demonstrated. (The NRC, however, refuses to release the expert's name.) Other AEC scientists have publicly stated their disbelief in AEC's assurances of ECCS reliability.

The fragile nature of reactor reliability and the inability of the Federal government to competently regulate nuclear power was recently demonstrated by an accident at the Browns Ferry station in Alabama. That accident was initiated when a hand-held candle started a fire in the polyurethane foam insulation surrounding some electrical cables. The fire led to the simultaneous failure of several redundant safety systems. It can be considered only a matter of luck that radiation was not released to the environment. The fire burned for seven hours, caused extensive damage at the $500 million reactor station, and will require the shutdown of two reactors for three to six months.

Even more shocking than the fact that a candle can cause a serious accident in a nuclear power plant, disabling a number of key safety systems, is the fact that the nuclear regulatory agencies were forewarned of this danger eight years ago by a fire in the polyurethane insulation of the Peach Bottom, Pennsylvania, nuclear power plant. The NRC's complex diagram describing their "defense in depth" safety strategy cannot mask the fact that they often do not learn from their own mistakes. Can we expect the NRC's safety regulation of the breeder reactor, a much more dangerous reactor, to be any more successful?

But technical questions aside, the most powerful refutation of the nuclear industry's safety claims is the Price-Anderson Act. This Act limits the accident liability of a nuclear operator to a pittance of the potential damages. But if nuclear reactors are so safe, as the utilities and NRC claim, why can't they be fully insured? To this question the nuclear industry has no satisfactory answer.

In addition to the safety problems of present reactors (known technically as light water reactors), industry is beginning to recognize that nuclear power is an economic disaster. Because nuclear power plants are much more complex, they cost much more to construct than conventional plants. Their greater complexity also makes them more temperamental, and they break down more often than conventional plants. Nuclear power thus threatens to affect the utility industry and consumers who pay the final bills through a vicious cycle: Expensive and complex nuclear plants, which strain capital supplies, are unreliable. Their unreliability necessitates the construction of more power plants, which in turn strains capital supplies still more.

Even if nuclear electricity could prove economical to private utilities, it would be only because of massive federal subsidies and economic distortions. These distortions include limited insurance liability, which permits utilities to pay only a fraction of true insurance costs; uranium enrichment, which is provided as reduced cost by government plants; reprocessing, which is made possible by government support for recovered nuclear fuel prices; security guards and waste storage, which services are or will be provided by the government.

In spite of all the direct and indirect subsidies of nuclear power, the industry is in danger because the nuclear fuel cycle which supports the power plant is crumbling.

The nuclear fuel cycle has five principal steps: mining uranium; enriching uranium so that it can be used in nuclear power plants; fissioning or "burning" of uranium in power plants; reprocessing and fabrication of the plutonium, a

[1] "Study of the Reactor Licensing Process" (uncensored draft) October 1973, Task Force Report to the Director of Regulation.

waste product of the power reactors, as a fuel for the reactors; and storage of unusable radioactive wastes. The entire "back end" of the nuclear fuel cycle has broken down. There are no reprocessing plants now operating and the plants under construction will probably not begin operating until 1977. Because no reprocessing plants are operating, wastes are building up in the temporary storage facilities at reactors. The build-up has become such a problem that ERDA has threatened to shut down existing reactors. The nuclear industry like the Japanese sailors who used dirty socks to stop a reactor radiation leak on Japan's first nuclear ship, is casting about for ways to "extend temporary storage capabilities".

The most crucial problem of all—"What is to be done with radioactive wastes that are toxic for 250,000 years"—remains unsolved today in spite of twenty years of promises and the claim that disposal is "only an engineering problem." There are as many solutions to permanent radioactive waste disposal as there are nuclear proponents, but when each solution approaches implementation it proves unworkable.

When our sewer systems become so overloaded that treatment plants cannot deal with the wastes, we impose sewer moratoriums and allow no new sewer connections. Does not rational social policy require that until the radioactive waste problem is solved, no new construction of nuclear power plants should be permitted? President Ford's reaction has been to recommend quadrupling of nuclear plant construction. Citizens are relying on the Congress for a more rational approach.

Before this country begins its headlong rush to develop the breeder reactor, it is logical to note the problems of LWRs and to ask if the breeder will solve these problems. The answer is that it will not.

I. The breeder reactor will not solve the problems of reactor safety. If anything, the breeder promises to be more deadly. The fuel for the breeder will be plutonium, one of the most toxic elements known to man. Less than one-millionth of a gram of plutonium has caused cancer in laboratory animals. Plutonium is also the raw materials of nuclear bombs. The coolant for the breeder will not be water but sodium, a highly corrosive substance which can react explosively with air or water.

The breeder reactor can experience an accident known as the Core Disruptive Accident. In everyday language, this technical euphemism means that the breeder can blow up. It is possible for the fuel to be rearranged such that it will undergo a small nuclear explosion on the order of a few 100 to a few 1000 pounds of TNT.

The breeder reactor threatens to undergo accidents that explode the reactor and release deadly plutonium. The catastrophic effects of a serious plutonium breeder accident could then exceed the catastrophic accidents possible with our present light water reactors. We can get some idea of the scope of a catastrophic accident in a plutonium breeder reactor, by describing the consequences of a severe accident in one of our present reactors. Many have used the AEC's Reactor Safety Study (Rasmussen Report) to argue that the consequences of a full scale nuclear reactor accident would not be severe. But, the American Physical Society, in its review of the AEC's Rasmussen reactor safety report, released on April 28, 1975, found the Rasmussen reactor safety report has badly underestimated the consequences of a nuclear accident. The Physical society concluded that a reactor accident would cause 10,000-20,000 deaths, 22,000-350,000 injuries, 3,000 to 20,000 genetic defects plus widespread and enduring land contamination.

As noted earlier, the government's ability to adequately regulate our present reactors is in serious doubt. Evidence recently has come to light that the same bureaucratic-corporate forces that undercut the light water reactor safety program, have put tremendous pressure on the NRC not to require necessary safety systems in the even more dangerous plutonium breeder reactor program.

The most recent evidence appears in the report of April 4, 1975 on the contractural arrangements between ERDA and the private utility participants in the Clinch River demonstration breeder reactor (CRBR). The purpose of the CRBR is to demonstrate the viability of the plutonium breeder concept. The proposed contractual arrangements permit the utilities to pull out of the CRBR project if a basic design change is ordered. The GAO report notes that a basic design change that may be required by the Nuclear Regulatory Commission is a safety device known as a "core catcher". One of the purposes of a core catcher, which a number of independent scientists believe is an essential safety feature if breeder reactors are built at all, is to stop a secondary nuclear explosion from occurring after an accident occurs in the reactor. The GAO report notes that "There are strong indications that the utility participants are opposed to including a core catcher in the CRBR design." Of course, if a core catcher is required and as a result the utilities pull out of the project, the viability of the plutonium breeder concept as a source of power for utility companies will not be demonstrated. The purpose of the breeder demonstration project is to show that the breeder program can be commercially viable—that is, that the utilities are willing to invest in plutonium breeders as a major source of electric power. If the utilities pull out as a result of NRC's requirement of a core catcher, the entire rationale for the Clinch River program will be negated.

The effect of this contract provision, which permits the utilities to pull out of the project if they do not agree with safety requirements, will be to put pressure on the Nuclear Regulatory Commission not to require the core catcher. As the GAO report states, "The possible consequences of a decision by the Nuclear Regulatory Commission that could make a core catcher necessary could place tremendous pressure on this regulatory agency in arriving at a decision."

II. The breeder reactor will not eliminate the problems and dangers of the uranium fuel cycle. Instead the breeder will require a supporting plutonium fuel cycle which is even more dangerous. Plutonium produced by the breeder will have to be reprocessed and fabricated into fuel rods. There will have to be tens of thousands of over the road shipments of plutonium per year from reactor to reprocessing plants to fabrication plants and back to the reactors.

It is reasonable to ask if the commercial sector has demonstrated an ability to handle and safeguard plutonium. The answer is that the commercial sector has demonstrated gross incompetence. In September 1974 *Science* magazine investigated the record of the four major commercial plants which have handled plutonium. The *Science* article concluded:

> ...it is hard to see that any of them is quite in command of the technology.
>
> The record reveals a dismal repetition of leaks in glove boxes; of inoperative radiation monitors; of employees who failed to follow instructions; of managers accused by the AEC of ineptness and failing to provide safety supervision or training to employees; of numerous violations of federal regulations and license requirements; of plutonium spills tracked through corridors and, in half a dozen cases, beyond plant boundaries to automobiles, homes, at least one restaurant, and in one instance to a country sheriff's office in New York.

Perhaps the most disconcerting feature of the commercial sector's incompetence is its inability to safeguard and account for this special nuclear material, which is also documented by the *Science* article. For in addition to its extreme toxicity, plutonium is the raw material of nuclear weapons. If just 10–20 pounds of plutonium are stolen it could be fabricated into an illicit nuclear weapon by a dedicated and skilled band of terrorists. This weapon, which could be carried in an automobile, would have an explosive potential of 100 tons of TNT. A recent NET television program illustrated this dangerous potential. As part of the program, the producers commissioned an average undergraduate science student to design a nuclear bomb. The student, in a short period, designed a bomb which experts from the Swedish Defense Ministry judged would probably explode.

The AEC estimated that by the year 2000, the commercial sector annually would handle 220,000 kilograms of plutonium (A kilogram is about 2.2 pounds). The limits of error in accounting for plutonium are presently acknowledged to be about 1%, which means that about 2 tons of plutonium would be routinely unaccounted for annually. But because 12 pounds of plutonium could be used to fashion an illicit nuclear weapon, the equivalent of 350 bombs could be fabricated and no one would miss the plutonium.

Even if a terrorist did not have the knowledge to fabricate a nuclear weapon, he could create havoc with stolen plutonium merely by threatening to release the material. Plutonium's extreme toxicity would present a severe hazard to any populated area in which it might be dispersed. The recent explosion of two bombs at a nuclear plant site in France illustrates the likelihood of such activity.

Clearly, if the country is to depend on a breeder reactor which uses plutonium as its fuel, the most extraordinary measures will have to be implemented to prevented (or, as is more likely, to detect) plutonium theft. One tentative NRC proposal would establish a federal plutonium police force to deter and investigate theft of nuclear material. Even if this national police force could prevent any plutonium theft, which is doubtful, the question must be raised as to what threat such a force would present to individual civil liberties. This country has already witnessed "no-knock" drug raids on the wrong house. In the event of plutonium theft, might not abuses of much greater severity be committed by a force working against time to recover the plutonium before it could be fashioned into a weapon?

The question that must be asked: Why spread such national security problems in the form of breeder reactors and its associated technologies around the country when there are realistic alternatives such as conservation, solar and geothermal in this time period?

Another NRC proposal for the safeguards problem is widespread background security checks on all persons who will be connected with the handling or transportation of plutonium. Even without plutonium the present generation of reactors has led to unauthorized surveillance of citizens. The Texas state police admitted that they compiled dossiers on nuclear power critics. The Virginia Electric and Power Company asked its state legislature to authorize the company to provide its own police force with the authority to arrest anyone anywhere in the State of Virginia and to gain access to confidential citizen records. After uranium pellets were found outside the Kerr-McGee fuel fabrication plant in Oklahoma and one of the persons raising questions about health and safety practices at the plant was killed in an auto crash under suspicious circumstances, Kerr-McGee asked its employees to "volunteer" to take lie detector tests. Employees were asked during these tests if they had any contact with anti-nuclear groups, were they active in union activities, and had they talked with the press. If these abuses occur even before a plutonium fuel cycle, implementation of plutonium recycle will entail the garrison-state mentality with manic background security investigations, routine lie detector tests and security clearances.

In summary, this country and the world are not ready for the "plutonium economy". Do we dare to proceed with a plutonium economy on the facile assumption that somehow, terrorist groups can be prevented from obtaining plutonium illicitly? How is it possible to develop adequate safeguards without unacceptable degradations of civil liberties? We know that the industry has a documented inability to handle plutonium. Concerns such as these have led responsible citizens to oppose not only the development of the breeder reactor, but also the interim proposal of recycling plutonium as LWR fuel. Stopping the plutonium breeder is a major cancer prevention program.

III. The breeder reactor will not solve the problem of radioactive waste; it will only add to it. The waste produced by the breeder will be comparable in amount and quantity to that produced by LWR's. The nuclear establishment has no more developed a disposal solution for breeder waste than it has for LWR waste. The present solutions discussed by ERDA, which are only proposals on paper, amount to no more than guardianship of the waste. In the best case, guardianship will be required for 1000 years; in the worst case, for a quarter-million years. These time periods will challenge not only the stability of human institutions but the stability of geological formations as well.

IV. The breedor program will not solve the economic problems of the nuclear industry. The Natural Resources Defense Council, which also testifies today, has made a convincing case that the breeder reactor program is simply not economically viable, is not necessary, and that a decision to go forward with it can be delayed for a decade without foreclosing our energy options. Their position that development of the plutonium breeder decision could be delayed was recently confirmed by the EPA's comments on the breeder programs environmental impact statement. EPA found that the A'EC had apparently overstated the growth of electric power demand in the years 1970–2020.

The cost overruns that have afflicited the breeder program indicate that, if anything, present predictions on the total costs for the program are too small. The entire breeder program was estimated in the mid-1960's to cost $2 billion. That amount has already been spent, but ERDA estimates another 8 billion will be necessary to complete the program. One component of the breeder program, the Fast Flux Test Facility (FFTF), was authorized in 1966 at $87.5 million. In June 1974, the General Accounting Office (GAO) estimated the cost of the FFTF program at more than $933 million—over ten times original estimates.

The second significant component of the breeder program is the Clinch River Breeder Reactor (CRBR), the breeder demonstration plant. The first official cost estimate for the CRBR, in 1973, was $700 million. In July 1974, the

CRBR cost estimates reached $1.7 billion dollars. The cost doubling time of the CRBR has been approximately one year, with the project completion date set for no sooner than 1982.

Even ERDA's corrected estimates that the breeder program will "only" cost $10 billion probably significantly understate the cost of the breeder program. ERDA's estimate understates the costs because they are based on unrealistic estimates of capital costs and because they do not include large hidden costs. With respect to the hidden costs, ERDA estimates include only $300 million for subsidies that will have to be paid to the operators of the early breeder reactors. This subsidy will be necessary because the costs of the electricity produced by the early plutonium breeders will be much higher than the costs of electricity available from other sources. The April 28, 1975 GAO report revealed that the total subsidies could be as much as $2 billion.

With respect to the unrealistic capital cost estimates, ERDA assumes that the capital cost of the Near Commercial Breeder Reactor (built in the mid-1980's) "could be as high as $1,000 per installed kilowatt of capacity," or approximately the cost for the LWR built in the 1980's after about 20 years of operating experience. It is difficult to believe that the Near Commercial Breeder Reactor, the first reactor of its size, will cost no more than the light water reactors 1980's model. It is much more logical that the NCBR, a first breeder reactor of its size, will have capital costs that are much higher than the costs of the light water reactors built during the same time period.

V. These figures are an impressive statement of the last drawback of the breeder, which is its usurpation of research funds. The Ford Administration would devote $500 million to the breeder reactor for FY 76. This amount is fully 35% of the total civilian energy research and development budget for FY 76. Nuclear energy projects altogether take up 67 percent of civilian energy research funds. It is significant that the last of the AEC's official projections of future plutonium breeder expenditures, $8 billion to program completion, exceeds a recent Federal Power Commission estimate of the total R & D costs of developing all non-nuclear, and far safer, technologies, including coal gasification, solar (direct and indirect) and geothermal technologies, advanced steam cycles, MHD, fossil fuel effluent controls, and a variety of energy storage systems.

One would assume that a program that absorbed such a large segment of the energy R & D budget would have the nearly unanimous support of the sicentific communtiy. That is not the case. The Pugwash Conference of International Scientists on Science and World Affairs which questioned the further development of nuclear power, challenged further development of breeder reactors because they heighten the risks of nuclear power.

Supporters of nuclear power have also doubted the wisdom of the present breeder program. W. Kenneth Davis, Bectel Corporation executive, in his dissent to the Report of the Cornell Workshops on Major Issues of Our National Energy Research and Development Program stated:

> The priorities and expenditures for the present LMFBR program need to be reexamined in light of competing needs, including such things as coal conversion R & D, and the probability of the present FBR program achieving a useful goal in the time required.

Specifically, in regard to the Clinch River Breeder Reactor, for which ERDA is seeking $181 million in order to move it into a construction phase, the 10/22 draft of the Bethe panel of the Cornell Workshop stated, "A reactor of such low performance is not a useful reactor at all." Congress cannot responsibly appropriate huge sums for R & D programs on which the scientific community is deeply divided.

As long as the energy research budget is so tilted to nuclear energy, nuclear power will be a self-fulfilling prophecy. The funds gobbled up by the breeder will forestall the deveolpment of safer, cleaner renewable energy sources. Such renewable sources include solar heating, geothermal and wind power, burning of garbage and conversion of waste to fuel. Each to these sources is in everybody use right now, in this country and abroad.

Any technical difficulties with these sources can be resolved much more readily than the difficulties of nuclear power which are not merely technical difficulties, but difficulties with an unstable world. The consequences of a renewable energy source accident would be infinitesimal beside the consequence of just one nuclear accident. For these reasons, the breeder program should be dropped, and a new and balanced federal energy research program should be established.

In summary, we have to judge the risks of the breeder by our experience with all other technologies. Other technologies, in spite of their promoter's claims, have suffered catastrophes.

No dollar was spared in the space program, but the Apollo fire occurred.

The Titanic was supposed to be unsinkable. It sank.

We were constantly assured by industry and Federal regulators that the public was protected from unsafe drugs, but thousands of babies were deformed by thalidomide. Who can assure that it will not happen in nuclear power?

Chairman HUMPHREY. We are going to proceed on the basis of hearing our witnesses and if the time permits we will come back to a limited amount of questioning. This subject matter is so filled with controversy and the need for examination that our question period will be totally inadequate.

We now have Mr. John Simpson of Westinghouse.

Mr. Simpson, we will hear from you. It is our understanding you are in support of a general program for a breeder reactor.

Go right ahead.

STATEMENT OF JOHN W. SIMPSON, DIRECTOR-OFFICER, WESTINGHOUSE CORP., AND PRESIDENT, ATOMIC INDUSTRIAL FORUM

Mr. SIMPSON. Thank you, Mr. Chairman.

Mr. Chairman, I am John W. Simpson, director-officer, and chairman of the energy committee, of the Westinghouse Electric Corp. I have been deeply involved in the nuclear program since 1946, first with the naval reactors program—Nautilus and Shippingport—and then as head of the Astronuclear Laboratory and our nuclear rocket engine program, and then in charge of the Westinghouse Commercial Nuclear Reactor Activities. Since 1967 I have been connected also with our breeder reactor program.

Today you are holding hearings on a matter of vital concern not only to the United States but to the entire world. True, other nations are developing breeder reactors and some may say they are ahead of us. These other nations also appeared to be ahead on the converter reactors, yet today U.S. light-water reactor technology is used throughout the world.

Today our Nation finds itself in a severe economic recession brought on in part by the energy crisis. Furthermore, I submit we can recover from this recession only if we take actions to guarantee the energy needed to restore the strength of our economy and to maintain it in the future. I call your attention to the charts attached to copies of my prepared statement.

As shown in exhibit 1 of my prepared statement, energy growth and GNP growth have historically exhibited a remarkable lockstep relationship. We cannot say that the availability of energy causes economic growth. But we can say with certainty that economic recovery and growth cannot occur unless adequate energy is available for processing and manufacture and the marketing, transportation and sale of goods, products, and services.

As an illustration of this I would like to read from a report on the National Jobs Conference held in Washington by the Building and Construction Trades, Department of the AFL-CIO in April:

Growing numbers of nuclear electric generating plants in the future will not only provide this country with the low cost electricity that is needed to keep the economy growing, but also provide an alternative energy source to oil and natural gas which must continue to decline as a source of power.

In addition, there will be a significant and beneficial impact on the U.S. work force, particularly construction workers, who will be needed to build a projected number of nuclear powerplants and to operate them. The labor requirements for nuclear plant construction are projected to increase about 17 times by the end of the century to 724,000 workers. The liquid metal breeder reactor is even more capital incentive. The LMFBR now under development in the United States will require an even larger construction and component energy work force than required for building LWR power plants. At the same time it also extends the period of time over which we can generate low-cost electricity for decades and centuries to come. The reactor will produce electricity costs lower than light-water reactors despite high capital costs.

Growing numbers of these plants can begin commercial operations in the 1990's.

For example, Mr. Chairman, as you know, our agricultural economy is based largely on the availability of low cost and abundant energy. Today, 13 percent of our total national energy goes for the production of food—just to get it to the grocer's shelf. On the basis of expected global population growth, it is estimated that merely to maintain current per capita consumption will require a doubling of world food production over the next generation. Even more energy will be needed in the future to improve the standard of living and, also, oil and gas will be needed as a base for fertilizer production.

Exhibit 3 of my prepared statement indicates that, if we are to recover from our current depressed economic state, then we must have a higher-than-normal energy growth between now and 1980. The future trends depicted on this chart make allowance for elasticity in energy prices, for conservation efforts which will result in a 10-percent savings in energy use by the year 2000 and a 20-percent savings by the year 2020, and for decrease in the productivity improvement and labor force growth rate.

Exhibit 5 of my prepared statement shows our base energy forecast through 1980. If we build all the nuclear plants and mine all the coal we can by 1980, economic recovery will take place only with sharply increased oil imports.

To provide our energy needs beyond 1980, the only reasonable alternative is a commitment at this time, before it is too late, to expand our nuclear capability as France, Spain, and Japan are doing; and to utilize more of our available coal resources.

As shown in exhibit 7 of my prepared statement, by expanding the use of nuclear energy and coal, we will move toward a greater portion of our total energy in the form of electricity, conserving remaining supplies of oil and gas for use where no substitutes exist—feedstocks for chemicals, plastics, drugs, fertilizers, and fuel for aircraft. By 1990, with accelerated coal and nuclear use, we can maintain economic growth and at the same time virtually eliminate oil imports.

As shown in exhibit 8 of my prepared statement, coal and uranium used in light-water reactors constitute 95 percent of our conventional energy resources, but so far provide only 19 percent of our needs. Obviously, they must provide the bulk of our future energy. But coal cannot do it alone.

Commercial nuclear power, in operation in this country for nearly 20 years, now involves 53 powerplants, producing almost 8 percent of the Nation's electricity. The nuclear performance record has demonstrated that nuclear power is safe, dependable, environmentally attractive, and economical. A late 1974 survey by the Atomic Industrial Forum showed that light-water reactors are providing electricity 40 percent cheaper than fossil-fueled plants.

The economy of nuclear plants is reflected in the household utility bills of those consumers fortunate enough to be using electricity generated by such plants. For example, Northeast Utilities in Connecticut and Massachusetts would have had to pay an additional $140 million last year for fuel if it were not for the fact that one-third of Northeast's electric generation is nuclear. That's an average saving of $140 a year for a million nuclear customers.

How about the period beyond 1990 and extending into the next century? This brings me to the need for the breeder reactor, specifically the liqiud metal fast breeder reactor which has top priority not only here in the United States but also in France, the United Kingdom, West Germany, Japan, and the Soviet Union.

Obviously, such people as Mr. Weinberg, of Oak Ridge National Laboratory, had their choices. But, by many engineers and scientists and engineers of the Government, the liquid metal reactor was chosen as the priority unit not only in the United States but in the Soviet Union, in France, and in West Germany.

Uranium, the basic fuel for today's light-water reactors, is a finite natural resource. The Energy Research and Development Administration has fixed known high-grade reserves of uranium at 700,0000 tons and unidentified, potential resources at 2.7 million tons. Our known reserves will be committed to fueling, for their lifetime, light-water reactors operating by the early 1980's, and even if we find the additional 2.7 million tons of uranium reserves, they would be committed to the lifetime fueling requirements for light-water reactors starting operation in the 1990's.

Incidentally, the cost of decommercialization is included in the cost of all of these plants.

The liquid metal fast breeder reactors, which produces more fuel than it consumes, uses uranium 60 times more efficiently than present nuclear reactors. It will extend from decades to centuries the period during which our domestic uranium resources can provide economical electricity, not only by using uranium more efficiently but by permitting use of more costly uranium.

Chairman Humphrey. May I just interrupt for a minute?

Do I understand that you are saying even if we find the additional 2.7 million tons of uranium reserves this would only be adequate for plants committed up to 1990?

Mr. Simpson. This is what is termed relatively low-cost reserves. But into the 1990's, it depends on to what extent one maximizes the nuclear commitment. If one maximizes it, it would go to the 1990's, if there is a lesser number it would go well into the 1990's.

Chairman Humphrey. Doesn't that include the application of the laser technology?

Mr. Simpson. No; it will obviously be cost effective if it can be perfected because it uses that uranium otherwise unused earlier. That will be eventually used in the breeder reactor in any event, but because it would be used after the year 2000 its present worth is considerably less.

However, as pointed out, even if the effectiveness of the laser technology is proved, which is by no means certain, it would take a long time to build the plant to provide enough uranium to make a very large difference.

As shown in exhibit 9 of my prepared statement, breeder reactors will gradually supplement light water and other nonbreeder reactor electrical generation capacity. By the year 2000, breeder plants will contribute almost 20 percent of nuclear generated electricity, and by the year 2020 this figure will have grown to almost 75 percent. Instead of having to strip for low grade uranium shales or import uranium, the LMFBR will provide us electricity to help drive an electric economy with no additional uranium mining to meet its fuel requirements.

It is not suggested that nuclear development be undertaken at the exclusion of all other energy research. Every promising concept should be pursued. However, all alternative sources such as solar, geothermal, wind, tidal, ocean gradients, and hydro together might supply only a few percent of our energy needs by the year 2000. Thus, principal reliance must be on coal and nuclear, with the breeder needed to extend the nuclear option for centuries to come if necessary.

The liquid metal fast breeder reactor is not a new energy technology. Since 1951, six experimental or test liquid metal cooled breeder type reactors have operated in the United States, and there have been larger power-producing plants abroad. Construction of the fast flux test facility, to test our breeder fuels and materials, is about 40-percent complete. The next major step toward commercialization is the demonstration plant at Clinch River.

As a prerequisite for commercialization, every new high technology concept, whether solar, geothermal, fission, or fusion, requires a demonstration plant to confirm performance characteristics—operability, reliability and maintenance—with industrially provided equipment developed beyond expermental versions. Without a breeder demonstration plant, industry and the financial community would lack the confidence required for commitments to commercialization.

It is planned that the Clinch River demonstration plant will achieve critically by July 1982, followed by a 5-year demonstration period as part of the TVA System.

A good deal has been said in public debate about the costs of the breeder program. Estimated costs of the Clinch River demonstration program, over a 15-year period from 1972 to 1987, include research and development, design and construction of the plant, and fuel, operating and maintenance costs for 5 years. Of the $1 billion increase over the 1972 estimate, about 75 percent is accounted for by increased allocations for contingencies—$150 million—and inflation increases—$600 million—that have hit every major program in this country. One example is the Alaskan pipeline whose cost estimate increased from $900 million in 1969 to nearly $6 billion in 1974—an increase of more than six times.

Ten billion six hundred million dollars is what the United States paid for less than 5 months worth of imported oil in 1974. This is the estimated cost of the entire breeder program which covers the period from 1950 through the end of this century. What are the benefits of that investment?

A recently completed "assessment of economic incentives for the liquid metal fast breeder reactor" done by experts of Harvard University, Commonwealth Edison Co., and General Electric Co., predicts a net economic benefit of the breeder for plants built through 2020 of $76 billion in discounted present value. If the dollar benefits were not discounted, but inflation alone factored out, the benefit would be $2.4 trillion, in reduced costs to produce electricity. If the total breeder development costs of $10.6 billion are present-value discounted to 1975, they become about $6 billion. Thus, as shown in exhibit 11 of my prepared statement, the projected economic benefits, in the form of reduced cost of electricity, are more than 12 times the cost.

Chairman HUMPHREY. Now, what does that mean?

Mr. SIMPSON. That means the value of the actual dollars of benefit to the year 2020, taking into consideration all of the costs and discounted at 7.5 percent back to today. It would be actually $2.4 trillion in undiscounted dollars.

Chairman HUMPHREY. Benefits to whom, who gets the benefits?

Mr. SIMPSON. The peope of the United States.

Chairman HUMPHREY. That is what I wanted to know. You get this professional language here and the purpose of these hearings is to educate the Members of the Congress who are not nearly as smart as we think we are and especially members of the public. I like to have all of this explained so that we folks understand it. I think you understand it. I want to get the point across.

According to your figures you are saying this is a $76 billion benefit, is that correct, to the public?

Mr. SIMPSON. That's correct. And on a sensitivity analysis, if there were twice as much uranium as we predicted, instead of $76 billion it would be about $44 billion. If it were a 5-percent instead of a 6-percent growth in the use of energy to the year 2000, it would drop to about $40 some billion. If it were higher it would go up to $120 billion. We also made a sensitivity analysis for all of the probable variances.

Chairman HUMPHREY. You have all of that exhibit II, I see here.

Mr. SIMPSON. That's right.

There are considerations which go far beyond mere dollars and cents in computing the ratios of costs and benefits, however. It would be a tragic record in history if through shortsightedness at this time we condemned our Nation to economic stagnation when, with the investment of the equivalent of a few months of imported oil costs, we could assure future generations of a virtually unlimited supply of economical energy.

Under normal operation the breeder will actually have less impact on the environment than any other technically proven power generating device. It will have less radioactivity release; much less air pollutant emissions—actually zero; less thermal, transportation and land use impact.

Unfortunately, as the scientists considered waste disposal or management a nonproblem, they did not communicate their thoughts very well to the public. These waste products will be relatively small in quantity and can be stored safely for thousands of years in geologically stable areas at an acceptable cost. Even less expensive storage methods may be developed or the long-lived components—the actinides—might even be recycled in reactors or other high level neutron sources and changed to shorter half-life isotopes. These are being worked on and safe engineered storage methods are available for the interim period if desired.

Current beneficial uses of radioactive waste derivatives include medical applications such as long-lived cardiac pacemakers and artificial hearts. They have been used in remote power sources, both in space and under the oceans. And applications are under development for use as low grade heat sources.

The liquid metal breeder reactor has several inherent safety features. Sodium coolant operates at near atmospheric pressure, which in turn reduces the potential for leaks. Guard vessels around components will prevent the system from draining even if leaks do occur, and thus asure the ability to cool the core. Also, the breeder fuel has a unique self-control capability which tends to automatically reduce any unanticipated increases in lower level. I might add it is necessary for the core to melt before any radioactive releases that would be damaging to the public would occur.

Because of the very excellent heat transfer properties of sodium and design of the coolant path, the breeder reactor will contiinue to be safely cooled by convection even if pumping power should be lost.

Sodium has been handled safely for many years in large quantities in commercial chemical processes as well as in laboratories and reactors in the United States and abroad. The technology for handling this liquid is well-known and the LMFBR designs are such as to make it possible to assure the safe handling of the sodium. We have considered and taken action to prevent any reaction with water or air.

Another important point is a better understanding of plutonium toxicity. Plutonium is a dangerous material, but it is by no means the most toxic. Critics use the minimum quantity injected directly into the blood stream with a 50-percent chance of producing cancer. Here they use a value only about one-tenth of the correct one but, more importantly, using injection into the blood stream is absurd. With the probable methods of intake—inhalation or food ingestion—the dose would have to be 3 times larger for inhalation or 30,000 times larger for food ingestion. Many biological agents are for worse. Plutonium in food is roughly hundreds of times less toxic than mycotoxins such as botulin, anthrax, and even some mushroom poisons.

Plutonium is less toxic than lead arsenate, selenium oxide, potassium cyanide and mercury dichloride. More significant yet, Plutonium compounds are heavy, nonvolatile, adhere to surfaces and are very difficult to disperse.

Estimates are that in any practical circumstance of plutonium released from a site, meteorology and buildings would reduce the effective dosage about 60,000 times, warning could give another factor of 10, and people could protect themselves by closing windows or even breathing through a handkerchief.

In weapons testing, 5 million grams have been dispersed and no public health hazard has been found. No effect has been found in the millions of grams handled with some accidental exposures. Plutonium effects are confined to a relatively small geographic area.

Sabotage of nuclear plants that might cause serious public risks is far more difficult to achieve than critics claim. It would take a group, highly technically trained in both nuclear technology and sabotage, working undetected, hitting just the right places at the right time, with no measures taken to block them or warn the public. Thus, the relatively small consequences to the public and the great danger to themselves make this a most unlikely event.

There are only a few places in the fuel cycle where it makes any sense to divert the material for illicit reasons. There are technical alternatives available if needed, such as denaturing and closed fuel cycles which avoid shipment. Moreover, the present physical protection, guards, communications, et cetera, which are being constantly technically improved can give us adequate assurance of safeguarding the material.

If history proves us to be wrong in the projections discussed earlier, and if the United States proves to use less energy, rather than more, then the American people will enjoy an energy surplus, with lower prices than if there is a shortage.

But if history proves those who disagree with us to be wrong, and if it proves that the United States needs more energy—and if the necessary systems have not been developed to provide that energy, the United States' problem will be one not just of shortage, but of survival.

The risk of being wrong is just too great to take.

[The prepared statement of Mr. Simpson follows:]

Prepared Statement of John W. Simpson

Introduction

The need for the breeder reactor, more specifically the liquid metal fast breeder reactor (LMFBR), must be placed in the perspective of our current and future need for energy, the sources available to meet these demands, and the role nuclear power in general, and the breeder reactor in particular, will play. Also, the much discussed issues relating to LMFBR costs and economic benefits, safety, environmental effects, safeguards and waste management must be addressed.

In discussing these points, the need for the LMFBR will become evident, as will the urgency for the continuation of the program leading to commercial plants in operation by the early 1990s.

Why we need energy—Our short-term problem

Today we find our country in a situation referred to by many as an energy crisis. In actuality, we find ourselves in what I feel is an economic crisis—a crisis from which we can recover only if we take action today to guarantee the availability of the energy we will need to drive our economy in the future. Before proceeding, there is one basic point that I would like to make.

As shown in Exhibit 1, energy is an essential ingredient of economic growth. Energy growth and GNP growth have historically exhibited a remarkable lockstep relationship, moving in almost complete concurrence. Exhibit 2 portrays this relationship in a somewhat different form.

It would be incorrect to say that the availability of energy *causes* economic growth, but economic growth certainly cannot take place unless adequate supplies of energy are available for the processing, manufacture, marketing, transportation and sale of the various goods, products, and services that make up the gross national product. Consequently, the workings of the economy will be inhibited to the extent that energy is unavailable or is priced out of reach.

While a one-to-one lock-step relationship has existed between energy and GNP in the past, we believe that a modest degree of uncoupling between these variables is both possible and probable in the future. That is, some degree of energy conservation or price elasticity effect is possible without an exactly corresponding drop in economic growth. It is sobering to note that the evidence for 1974 does not yet show any uncoupling. During the unstable economic and energy conditions of last year, both energy use and economic growth declined by the same two percentage points, while unemployment increased three percent.

This nation is committed to raising the standard of living of the less fortunate—the "have nots." A blind commitment to a policy of deliberately restrained energy production would not only foreclose this possibility, but also reduce our own standard of living.

Recently completed Westinghouse economic and energy forecasts indicate that if we are to recover from our current depressed economic state, we must have a higher than normal energy growth rate between now and 1980. This is shown graphically in Exhibit 3, which gives real GNP and energy consumption plotted with the respective GNP and energy consumption trend curves. The trends for the future assume that elasticity-conservation effects will cause the growth in energy to lag the growth in GNP by approximately 0.4%.

What this curve says, in effect, is that if economic recovery is to take place over the next five years, more energy must be available and must be used at a higher rate than normal—at a time when we are facing the prospect of level or declining production of domestic energy fuels.

The bar graph in Exhibit 4 displays the magnitude of our resources contrasted with usage. Natural gas and oil constitute a minute percentage of our domestic energy resources; yet, from a usage standpoint, they account for more than three-quarters of all the energy we consume. Clearly our energy usage is dangerously out of balance with our energy resources.

Our base energy forecast through 1980, which allows for economic recovery from the recession, is shown in Exhibit 5. This shows nuclear power installations with moderate slippage from current schedules, coal production expanding swiftly, oil increasing with the availability of Alaskan oil through the pipeline toward 1980, and natural gas tapering off significantly.

With the rapid increase in total energy requirements and relatively flat domestic production, only a sharply higher rate of petroleum imports will allow the economy to recover back to trend as we had projected.

As the economy begins to recover and total energy requirements increase, a large increase in oil utilization, probably via imports, is required through 1980, and will continue at very high levels throughout the 1980s. In view of this rapidly increasing importation pattern, it is highly questionable whether imports will be available to us, either on political or economic grounds. To show the impact of not obtaining these imports, we have defined a set of "lower-bound" conditions, where oil imports are limited to the 1973 value of 6.1 million barrels/day. Truncating the imports curve would not allow full economic recovery and would choke off economic growth.

Taking that import restriction as the lower-bound case, we can compare growth in energy usage, GNP, and unemployment in Exhibit 6. With imports restricted, economic recovery is delayed until the post-1990 period, with unemployment averaging in excess of 10% over the next 15 years. The levels of unemployment that relate to the lower-bound case are intolerable. If such a protracted economic slump should occur, it is obvious that major changes would take place in the U.S. economic and political structures. It is not likely that the nation has sufficient resources to keep the implied large number of unemployed at even the subsistence level for that period of time. We would see the emergence of innumerable schemes for income redistribution and federal allocation of resources. This does not have to happen.

With a true national directive to expand our nuclear capability—such as has been the case in France, Spain, and Japan—we can achieve the virtual elimination of oil imports around 1990, as shown in Exhibit 7.

In expanding the use of nuclear power and coal, we will move toward the utilization of a greater fraction of our total energy in the form of electricity. With a greatly expanding electrical energy base, we would be able to significantly conserve the remaining supplies of oil and natural gas and use them primarily in applications for which no substitutes exist—feedstocks for chemicals, plastics, drugs, and fuel for aircraft.

Thus, over the first period between the present and 1980, we can achieve economic recovery, but most probably only by increased oil imports.

Between 1980 and 1990, we can gradually eliminate our dependence on petroleum imports by implementing plans today to provide more of the energy we need in the form of electricity generated by coal and uranium used in light water reactor (LWR) nuclear plants. As shown in Exhibit 8, coal and uranium, used in LWRs, constitute more than 95% of our conventional energy resources, but provide today only 19% of our needs.

How about the period beyond 1990 and extending on into the next century? Now is the time to firm up our policy and plans to guarantee that we have energy at the lowest possible cost and in sufficient quantity to sustain a healthy economy and minimize the economic, political, and national security consequences of an energy policy based on significant import requirements. This brings us to the time period when we will need the breeder reactor; specifically the liquid metal fast breeder reactor, which is presently the top priority energy development program not only in the U.S., but also in France, the U.K., West Germany, Japan and the Soviet Union.

Before moving forward, I would like to look at the long-term energy needs which we see as necessary to sustain a healthy economy and consider what energy sources are available to provide this energy. Specifically, I will key on the years 1985, 2000 and 2020.

Future energy needs

The total energy used in the U.S. in 1974 was 74 Quads (Quad is 10^{15} Btus). We project total U.S. energy demands in 1985, 2000, and 2020 to be 107, 145, and 210 Quads, respectively. Thus we see energy demand doubling over the next 25 years and tripling by 2020.

The corresponding annual percentage growth rates projected are 2.6% in 1985, 1.8% in 200, and 1.6% in 2020.

As I mentioned earlier, a one-to-one lock-step relationship has existed between energy and GNP in the past, but we believe that a modest degree of uncoupling tween these variables is both possible and probable in the future. That is, some degree of energy conservation or price elasticity effect is possible without an exactly corresponding drop in economic growth.

A modest degree of uncoupling is possible. Some housing is being reinsulated; automobile mileage will increase; industry is taking steps to increase energy-use efficiency. We project that these elasticity-conservation effects will cause the growth in energy to lag the growth in GNP by approximately 0.4% in the future. This represents a 10% reduction in energy use by the year 2000 and a 20% reduction by the year 2020. The energy forecast presented of 145 Quads by the year 2000 has already taken this reduction into account.

Some people have stated that they feel energy conservation can itself be our long-term salvation. This is just not true.

In discussing limits to conservation, it is assumed that the modern industrialized society will continue. Per capita energy use in primitive agricultural societies has been estimated to be 1/20 our current per capita usage, but this "simpler" life is not considered the desired goal of American society as a whole. With a vigorous program of research and development coupled with appropriate governmental action, a 20% reduction in energy usage by the 2000 was identified as feasible in "The Energy Report to the President—1974," which agrees well with the 20% energy saving use that has been possible in some industries.

Reductions of greater than 20% by the year 2000 would require a 0.75% uncoupling between GNP and energy use and result in a 40% reduction in the energy use by 2020. Reductions of greater than 20% by the year 2000 would probably require significant changes in our social, economic, and political system. Our forecast of 145 Quads by the year 2000 is only slightly higher than the 124 Quads of the Technical Fix Scenario of the Ford Foundation Energy Policy Project.

Energy conservation alone is insufficient—conservation of resources must also be considered. As an example, if the Technical Fix Scenario of the Ford Foundation's Energy Policy Project were followed our entire domestic resources of oil and gas would be depleted by the end of this century. Energy conservation alone is not enough—this nation must conserve its oil and gas resources and substitute our most abundant fuels, coal and uranium, whereever technically and economically feasible.

While energy growth projected for the future is significantly reduced from that experienced in the past, electrical energy will continue to assume a greater role in total energy production. The transition is already taking place and will accelerate in the future.

We project the electrical energy component of total energy consumption in 1985, 2000, and 2020 to be 42, 87, and 146 Quads, respectively, or as installed electrical generating capacities of 890 GWe (1985), 1886 GWe (2000), and 2860 GWe (2020).

In 1974, electrical utility input energy was 20 Quad, with an installed electrical generating capacity of 474 GWe. The electric utility energy inputs translate to approximately 27% of total energy in 1974, 39% in 1985, 60% in 2000, and 70% in 2020.

Recently reduced electrical energy growth rates have led some to believe that electrical growth will stay very low or level off in the near future.

In considering the long-term implications of the recently reduced electrical energy growth rates, one must decide what factors contributed to this reduction, the factors' respective contributions, and whether these or other factors may be expecetd to influence electricity usage in the future.

The termination of growth in 1974 was due primarily to a one-shot conservation effect stimulated by an intensive public information program, with secondary effects from the slowing down of the economy, whereas we expect the very slow growth rate in 1975 to be due to the same factors, but with the general poor economy being the driving force and the "conservation ethic" and possibly a limited price elasticity impact being secondary.

Therefore, the most recent experience is more of a perturbation than an indication of future nil electric growth rates, assuming the availability of generating fuels and a slowly recovering economy as previously discussed.

As a matter of fact, there is every possibility of a short fall of electrical generation capacity, especially in certain geographical areas, as the demand for electricity temporarily surges in the 1980–1985 period due to the economic catchup effects and a realization that electrical energy is a comparatively easy substitutable form of energy use. It is clear that the nation must switch to an electric economy to assure the full utilization of the major available energy resources of uranium and coal.

Over the next 25 years, total energy consumption will double; electric input energy will quadruple; and electric utility input will be about 60% of total energy consumption by the year 2000, and an astounding 70% by the year 2020. This will require extensive financing and other resource commitments, construction of generating capacities on an annual basis far exceeding our previous experience, and certainly the long-term implications for the electric utility industry and for the nation are very significant.

What energy sources will provide our future demand

The future production of our most used fuels, oil and natural gas will decline rather than increase in the future. The Federal Power Commission issued a report in December 1974 which stated that the peak in domestic natural gas production has been reached and that future production will continually decrease. The National Academy of Sciences issued a similar report in February 1975 describing an identical future for domestic oil production. Both these reports confirm the thesis of M. King Hulbert of the U.S. Geological Survey, who in 1954 predicted the peaking of U.S. oil and natural gas production in the early 1970s and their subsequent inevitable decline.

With the limited potential from other sources such as hydroelectric power, it thus becomes incumbent upon coal and nuclear sources to assume the dominant roles, and a large percentage of their assumption, of course, will be in the form of electrical energy. Despite the long-term slowing in the growth rate of electricity, the future electric economy becomes inevitable.

The projected U.S. energy balance for the selected years of interest will be about that as shown below:

Year	Quads							
	Oil and NGL	Natural gas	Coal	Nuclear	Hydro	U.S. production	Total demand	Difference (imports)
1975	21.3	25.2	15.5	1.8	3.3	67.1	71.9	−4.8
1985	24.6	19.8	26.5	10.2	3.5	84.6	106.8	−22.2
2000	21.5	8.8	72.5	45.3	3.5	151.6	145.4	6.2

Source: Derived from Hubbert and other sources.

By the year 2020, total energy demand is expected to increase to approximately 210 Quads, with coal and nuclear power being dominant in the form of electrical generation.

Although it is expected in the long term that nuclear power may be used for process steam, in direct processes, such as in steel-making and hydrogen production, and dual-purpose use, such as power generation-desalination, most nuclear power will be used in the generation of steam for electricity.

The expected nuclear electric generating capacity as projected for 1985, 2000, and 2020 will be approximately 206, 1023, and 1983 giga-watts, respectively. These nuclear capacities translate to approximately 23% of total installed electric generating capacity in 1985, 54% in 2000, and 69% in 2020.

The mix of reactor types, measured as the percentage of installed nuclear capacity, is expected to be about 96% LWRs, 3% HTGRs, and <1% Fast Breeders in 1985; by the year 2000, the mix will be 71%, 12%, and 17%; and then in 2020, about 21%, 6%, and 73%, respectively. We expect that there will be no new additions of LWRs and HTGRs after about the year 2005. Further, the number of non-liquid metal fast breeders will be small during the forecasting period.

The non-breeder and breeder contribution to project electrical generating capacity is shown in Exhibit 9.

As previously stated, the major shifts in our energy sources in the future will be away from oil and gas dependence to coal and nuclear power.

Coal and nuclear lend themselves readily to the production of electricity, whereas they cannot easily fill other needs, such as transportation. The nuclear option is, of course, heavily dependent upon the development and implementation of commercial breeders and plutonium-recycle in the LWRs, which will extend the availability of economically competitive uranium fuel.

The importance of coal and the demand to be placed upon it cannot be over emphasized. Coal reserves represent our single largest known source of fossil fuel. Technology can be advanced to the point where coal can be produced and used in large quantities, and low Btu gas from coal will probably be the first synthetic boiler fuel to gain commercial acceptance.

It is not expected that energy forms such as geothermal, solar (for electrical generation), tidal, wind, and the like will make a significant contribution by the year 2000, nor a dominant source ever. The fusion option may represent the ultimate electric generating fuel; however, we do not expect more than a token commercial contribution before the year 2020.

Alternate sources of energy, such as solar and geothermal, can provide only a small part of our needs by the end of this century. Solar energy might provide about five percent of our energy needs by the year 2000, mostly to heat and cool buildings. Hydro power will contribute approximately 3% of our energy needs in the year 2000. If all our harbours were equipped with tidal plants, only 1% of the energy needs of today could be generated. Geothermal power generation is limited geographically. It would provide only 1% of our needs by the year 2000. The efficiency of ocean thermal gradients is so low and the cost so high that Westinghouse expects their impact on the energy supply situation in the year 2000 to be negligible.

The use of windmills as an energy source may supply up to 1% of our energy needs by the year 2000. Fusion is a great potential energy source, but technical feasibility has not yet been determined. Even with increased developmental effort, no contribution to the commercial energy sector can be expected before several decades into the next century. All alternate sources together might supply about 10% of our energy needs by 2000. Thus, principal reliance must remain on coal and nuclear power, with the breeder needed to extend the nuclear option for centuries, if necessary.

The expected "freeing-up" of the oil and gas fossil fuels now used in electrical generation will then meet the continued demands for petrochemical feed materials to plastics, medicines, and fertilizers, and for transportation needs.

The path to near-term (1980) economic recovery and growth and the steps required to assure adequate energy sources to support that recovery and growth seem very clear. The nation must accept the necessity of relying upon increasing oil utilization through this decade and must accommodate itself to that inevitability. Aggressive programs must be initiated and accelerated today to boost the production and utilization of coal and nuclear energy. This requires a shift to electricity as the nation's primary end use energy form. In the interim, energy conservation must play an important role. However, conservation is a short-term necessity and not a long-term energy option.

The issue of reliance on imports also requires some discussion. A decision on the degree of oil imports considered acceptable depends on several factors. One is this nation's ability to pay the bill and this largely depends on money from the exports of food and high technology products. A second consideration really involves a foreign policy decision concerning reliance on an unstable foreign supply and the flow of wealth to a few countries.

A third factor is the need for oil imports to provide the energy for recovery from the current recession. Our analyses show that with sufficient energy supplies, full recovery from the current recession can take place by 1980 (Exhibit 3—the upper bound case). Because of decisions made in the last few years and the long lead times involved in building up domestic energy supplies, imported oil most probably will have to be used from now until the 1980s to fuel our economic recovery. If forced to rely on imports, we will, by 1980, need to double our current oil import level or face the prospect of continuing poor economic conditions. If oil imports are restricted to the 1973 levels of 6.1 million barrels/day (Exhibit 3—lower bound case), unemployment does not drop below 10% until the late 1980s.

If this nation is to remain economically healthy, we will *have* to import increasing amounts of oil in the next ten years. If we want to diminish this dependence by the late 1980s *and* maintain economic growth, decisions must be made *now* to expand the use of this nation's two most abundant energy resources, coal and nuclear power.

If we continue to rely on oil to the degree that we now do, and if we depend on imports to make up for our depleting domestic reserves, the results could be disasterous. Exhibit 10 summarizes this situation. By 1985, 53% of our oil would be imported at a cost of nearly $50 billion, and by 2000, almost 70% of our oil would be imported at a cost of over $90 billion. The economic, political, and national security implications of this are staggering—and clearly unacceptable.

Why we need the breeder reactor

This year, light water reactor plants will provide 8% of the U.S. electrical needs. This is equal to the total electrical power production that this country required in 1940—so this is not an insignificant amount of power. As indicated earlier, nuclear power will rapidly increase its contribution to total electrical generation in the U.S. In fact, LWR plants are today the cheapest way of producing electricity.

A survey by the Atomic Industrial Forum showed that in 1974 LWR plants had an average power generation cost (including amortization of capital costs) of 10.52 mills/Kwh versus 17.03 mills/Kwh for fossil-fueled plants. Nuclear power was 40% cheaper. Utilities with significant nuclear capability did not have as extreme rate runups as did those dependent solely on fossil-fueled plants.

The economic advantage of today's LWR plants is due to low fuel costs which result from the availability of high-grade (1000 to 2000 parts per million uranium) low-cost uranium ore deposits. LWR's are able to use only about 1.5% of the energy available in naturally occurring uranium, while the breeder reactor will use 60% or more of the available uranium energy.

If we had an infinite supply of uranium, we would not be discussing the breeder. However, current estimates indicate that our domestic high-grade uranium ore is limited to the degree that we may face serious economic and environmental decisions sometime during the 1990s with regard to obtaining the uranium we need. The breeder will eliminate this concern and extend the nuclear option of economic electrical power from one of many decades to centuries, if needed.

The September 1974 data from the Preliminary National Uranium Resource Evaluation Program of ERDA indicated that there are about 700,000 tons known of high-grade uranium reserves and about an additional 2.7 million tons of potential (unidentified) high-grade resources. Using the electrical demand projection given earlier, and assuming plutonium recycle is implemented in light water reactors in the late 1970s, the conclusion is reached that we do need the breeder reactor, and we should have them available for operation on a commercially competitive basis by about 1990.

The known reserves of high-grade ore are estimated to be committed to fueling, for their lifetime, light water reactors operating by the early 1980s, and *if* we find the additional high-grade potential resources, they will be committed to fueling light water reactors in operation by the mid-1990s.

The liquid metal fast breeder reactor will use uranium 60 times more efficiently than present generation reactors, and extend from decades to centuries the period during which our uranium resources can provide economical electricity.

If we do not have a commercial breeder by the time we approach depletion of our high-grade uranium resources, we will be forced to mine significant amounts of low-grade ores, probably the Tennessee shales, with a resultant environmental and economic penalty. Another option, if environmental pressures prevent stripping the shales, will be to become dependent upon foreign uranium—probably available for import only in enriched form, at highly inflated prices, due to high world-wide market demand for uranium toward the end of the 1990s. However, this would put us in the same position of vulnerability to blackmail that presently exists relative to the OPEC states and oil.

These costly consequences can be prevented if we have the LMFBR ready for commercial operation by about 1990. Instead of having to strip for low-grade uranium shales or import uranium, the LMFBR will provide us electricity to drive our economy with *no* additional mining to meet its fuel requirements. Plutonium from light water reactors will provide the initial core fuel, and depleted uranium tails (220,000 tons are stockpiled already) will provide all the fertile material needed for breeder reactor operation throughout the next century, if needed. With the breeder reactor operating commercially beginning about 1990, the available high-grade uranium ore will be sufficient for continued fueling of light water reactors for several decades into the next century.

Extensive examination of all possible options over the past ten years and longer by responsible and knowledgeable leaders in independent organizations, as well as in the Administration, the Congress, industry, and the scientific community, have consistently concluded that the breeder provides the best hope for meeting these national needs for economical, clean energy. The advantages of developing the breeder as an alternative energy option far outweigh the attendant disadvantages, known and postulated. On this basis, the highest national priority has been sustained for the LMFBR R&D program in order to develop a broad technological and engineering base which could lead to the establishment of a viable breeder option for large-scale generation of electricity in the early 1990s. The principal reasons for the assignment of the highest priority to the breeder program included: conservation of natural resources; maximum protection of the environment, as well as of the health and safety of the public; minimum overall risks; and maximum benefit. When compared to the other energy alternatives, the LMFBR was selected because of satisfactory predicted performance; unprecedented government, industrial, scientific, and utility involvement and support; a broad base of technological experience, including many operating experimental facilities; and its prospects for being brought into the demonstration plant phase and commercial usefulness in a relatively short time.

Breeder development: Cost benefits

The feasibility of the LMFBR as a significant power producer is unquestionably established. This country has a 30-year background in the applicable technology, starting with the nuclear plant for the submarine Sea Wolf and its prototype after World War II. Experimental Breeder Reactor II has now been operating extremely reliably at the National Reactor Training Station for ten years. The SEFOR reactor in Arkansas successfully demonstrated vital safety aspects of the self-shutdown and self-control capabilities for the breeder. Japan, Italy, West Germany, Britain, France, and the USSR have designated the LMFBR as their highest priority R&D program. The last three countries have all operated successful experimental breeder facilities for a number of years. These reactors, like the Fast Flux Test Facility (FFTF) now under construction, are special purpose experimental reactors. In addition, the USSR has built a breeder demonstration plant for generation of power and desalination (with an equivalent power plant rating of 250 MWe). This plant has been operating on the shores of the Caspian Sea since 1972. The French Phenix reactor (250 MWe) has been operating successfully for more than a year. The British will commission their prototype breeder (250 MWe) in the very near future. The breeder concept is being vigorously pursued around the world as the best option for providing clean energy to industrialized nations.

Any R&D program requires a demonstration phase that will show, through actual experience, how all of the essential components of a facility function individually and as a coherent system. This phase is a vital element of every R&D program, whether for defense, the commercial sector, space, or any other important purpose.

It is from the demonstration plant phase that hard information would be obtained on the complex interaction of the system with its associated supporting facilities and with the local environment under actual operation conditions. A firmer grasp would be obtained on the range of costs and technological factors of importance to further development and use.

Such a demonstration plant program is particularly important for each and every energy concept which has successfully proven feasibility—including synthetic fossil fuels, solar, wind, geothermal, tidal, and fission. Its results are essential to obtain the support of the producing and operating sectors of the free-enterprise system, as well as the public, for investment and commitment to proceed into the commercial phase.

The U.S. LMFBR development program is well on its way to providing commercial plants by the 1990s—when they will be needed.

Construction of the Fast Flux Test Facility is about 40% complete. It will serve a unique role as a non-electrical generating fuel and reactor materials test vehicle beginning in 1978.

The LMFBR technology is in place. The need exists for the breeder and the time for its commercial introduction is well defined by our future energy demand/supply projections. All that remains to guarantee its commercial acceptance is the utility environment demonstration phase.

The Clinch River Breeder Reactor Plant (CRBRP) design is well along and long-lead materials and components are being ordered. This plant is scheduled for operation on the TVA network beginning in 1982.

The Clinch River Breeder Reactor Plant (CRBRP) will satisfy the necessary requirements of a demonstration plant. We need it, its role is unique, it has support, and it is well on its way. Supportive facts are:

The feasibility of the liquid metal cooled breeder reactor concept has been unquestionably established by experimental reactor operation in the U.S. and by larger power producing plants abroad.

It has the overwhelming support of the electric utility industry—over 700 utility organizations ranging from small rural cooperatives to giant public and private power systems are contributing $260 million in a time of tremendous financial stress. Thus more than two-thirds of our utilities, who appreciate the breeder's need, are directly supporting the project.

It is a necessary step in the technical evolution of plant equipment and hardware. It is developing and will use equipment approximately three times the size of the largest LMFBR test reactors.

Its equipment and hardware is prototypic of the future commercial plants; somewhat smaller than will be required for commercial plants, but extrapolatable to commercial sizes.

It is the key step in developing an industrial component manufacturing base for the future commercial industry. It has the full support of the nuclear equipment industry. Over 10,000 employees of 272 manufacturers from 34 states throughout the U.S. are currently involved in LMFBR equipment production for the FFTF. The Clinch River effort will further expand this base.

It will demonstrate reliability, maintainability, and safe operation in an electrical utility environment.

It will fully develop the necessary safety, licensing, and environmental precedents in an open regulatory forum. Unlike the early light water reactor demonstration plants, it will be licensed as any other commercial nuclear power plant. This will result in greater confidence in the licensability of future commercial breeder reactor plants—a necessary step for early commercial acceptance.

It is the necessary technical and industrial springboard for commercial-sized plants. To go directly from FFTF to commercial-size plants would leave many questions unanswered and minimize the possibility of utility and industrial manufacturer investment necessary for commercial implementation.

At present, the Clinch River Project has the benefit of a more exhaustive reference design effort, detailed planning, and carefully developed and reviewed cost estimate than any other comparable project has ever had at an early stage.

The Cinch River Project has attempted to learn from the buildup and prior experience of the FFTF Project. The new Clinch River organization will further enhance the efficiency of the effort. The time is ripe to go forward.

The Clinch River demonstration plant is necessary for commercial acceptance of the breeder, and its present schedule is consistent with the goal of commercial operation of LMFBRs by the time they are needed.

Since 1972, the estimated cost of the CRBRP program has increased significantly, with 60% of the cost increase being directly related to inflationary effects of the type experienced by all large, complex projects during this period.

The following table summarizes the cost changes that have occurred as a result of changes, delays, and other factors since 1972, and are those previously reported to the Congress.

Clinch River program cost increases:

	Millions
1972 estimate	$700
Transfer of certain R. & D. programs into project costs	70
Increased contingency allocation	150
Design changes:	
(a) For maintenance and constructability	55
(b) For more conservative licensing requirements	165
Subtotal	1,140
Inflation effects (2-year delay in start of of program, 8 percent versus 5.5 percent escalation rate, 1 year longer construction schedule—escalation based on $1,140 million versus $700 million)	600
Total	1,740

The majority of the cost increases which have occurred are as a result of inflation and other effects that have hit every major program in this country, including those that do not involve R. & D. Additional contingencies have also been provided to increase the conservatism in the estimate.

It should be kept in mind that the $1.74 billion cost estimate covers a period of 15 years, including five years of demonstration plant operation. The actual plant capital cost is $1.1 billion, including $616 million in direct plant costs, $186 million in contingency, and $322 million in escalation during construction.

The estimated total LMFBR development program costs have also increased during this period of inflation. This program cost estimate covers the period beginning in 1950 and extending to the end of this century. The program itself covers research, development, construction, and demonstration. Specific elements are reactor physics; fuels and materials; fuel reprocessing; fuel fabrication; safety; component development; and construction and operation of EBR–I, EBR–II, FFTF, CRBRP, and other facilities. The table below summarizes the reasons for the total program costs increasing from $3.3 billion in 1968 (1968 dollars) to the current estimate in 1976 dollars of $10.6 billion.

Total LMFBR program costs:

	Billions
Original estimate (1968 dollars)	$3.3
Scope changes since original estimate	3.2
Escalation (1968–76)	3.6
Costs up to 1969	.5
Total current estimate (1976 dollars)	10.6

While the total program cost estimate of $10.6 billion is large, the benefits from the breeder will also be large. Also, it is put in better perspective relative to energy expenditures when we realize that $10.6 billion is less than five months worth of our 1974 oil import bill.

The benefits of the breeder, measured in terms of savings to the nation's power customers, will be large. Introduction of power generating stations by the 1990s will save the nation billions of dollars. Besides power cost savings, the LMFBR will aid the U.S. balance of payments situation by decreasing the demand for imported energy resources. The brief history of nuclear power demonstrates the economic benefits and the return available from a relatively small R&D investment. The cost of developing the LWR over a 20-year period totals less than $2.5 billion. Yet this investment has nurtured an indusrty, still in its infancy, with current capital commitments of nearly $100 billion and fuel commitments estimated at $200 billion. The LMFBR investment can be expected to perform similarly.

The most recent and by far the most thorough and realistic economic analysis of the LMFBR is "An Assessment of the Economic Incentive for the Liquid Metal Fast Breeder Reactor," by T. R. Stauffer (Harvard University). H. L. Wyckoff (Commonwealth Edison Company), and R. S. Palmer (General Electric Company). In this assessment, the economic benefits of the breeder to the nation are determined by estimating the long-term cost of electric energy if the breeder is not available and comparing this to the cost if the breeder is available. These costs are measured in terms of basic national resources, labor and materials, with transfer payments such as income taxes and financing charges excluded.

For the base case, the benefit of the breeder to the nation is $2.4 trillion (excluding inflation), which is $76 billion when present-value discounted to 1975.

By 2020, the annual fuel cost savings due to the breeder are nearly 45% of the nation's annual cost of fuel if the breeder were not developed. The growth of breeder capacity was limited only by the availability of plutonium, and by 2020, about 45% of the nation's electricity was generated by breeders.

In the base case, the capital cost of the breeder was 25% greater than that of a light water reactor. However, even if the capital cost of the breeder were twice that of an LWR, the benefit would still be $31 billion.

In one analysis, the projected amounts of uranium in all grade ranges were doubled over present estimates. The discounted benefit of the breeder was still found to be $44 billion. The benefit persists because doubling the nation's uranium resources defers the need to turn to lower grade uranium ores by only 10 years—from the year 2000 to the year 2010.

The base case assumes a conservative annual electrical growth rate of 6% between the years 1975 and 2000 and 4% between 2001 and 2020. Two other cases bracketed the growth levels in the base case. The results of these cases were:

Annual growth rate (percent)		
Years 1975–2000	Years 2000–2020	Discounted incentive for breeder (billions)
7	4.5	$122
6	[1] 4.0	76
5	3.5	48

[1] Base.

Price elasticity effects were not considered. If the breeder results in lower energy costs, the use of energy may be greater, with attendant improvements in the national standard of living that are not reflected in this analysis.

If the introduction of the commercial breeder is delayed ten years to 1999, the discounted benefits of the breeder drop to $43 billion, and if it is delayed to the year 2009, the benefit is only $19 billion. This reflects the added resources consumed and increased energy costs that will occur during the period of delay.

In the base case, advanced converters, such as the HTGR, accounted for 25% of the non-breeder reactor capacity. If they should claim only 10% of this market, the discounted benefit of the breeder would be $95 billion. If the penetration of these reactors should rise to 40%, the benefit of the breeder would be reduced to $59 billion.

These results show that advanced converters cannot greatly affect the nation's overall need for the fast breeder nor take the place of the breeder in conserving the nation's uranium resources. Even if converters are optimized to minimize their use of uranium, the need to turn to the lower grade uranium ores would be deferred only a few years.

All the cases investigated showed one common result; unless large reserves of high-grade uranium ores are discovered by the turn of the century, the nation will be dependent on coal and low-grade uranium ores for most of its energy needs. The introduction of breeders can transform the low-grade uranium ores into an energy source of 300,000 to 600,000 Btu's per pound rather than 10,000 Btu's per pound, as when used for LWR fuel. The breeder will minimize the combined tonnages of coal and uranium ore to be mined. In the absence of the breeder, the total coal and uranium mining effort by 2020 would be 12 times today's rate and still climbing. With the breeder, it would be six times today's rate, with a ceiling and ultimate decline to lower levels within sight.

If the total LMFBR development costs of $10.6 billion are present-value discounted to 1975, they become about $6 billion. Thus, as shown in Exhibit 11, the projected economic benefits to the U.S. are more than 12 times the cost. Although a cost/benefit analysis cannot be the only criteria for proceeding with a program involving major investment, we do feel that the estimated benetfis contribute heavily to the need to continue the LMFBR development on as rapid a schedule as possible.

Breeder capital costs

The economic benefits analysis referred to projected a $76 billion benefit if the LMFBR plant capital cost were 25% greater than that of an LWR plant. It also indicated that even if the plant capital cost of the LMFBR were twice that of an LWR, the economic benefits would still be significant—$44 billion. We feel that the LMFBR plant capital costs will be within 25% of LWR capital costs by the 1990s. This will result in the total power generation costs (capital and fuel) being about equal or less than that for LWR plants because of the significantly lower LMFBR fuel costs.

All of our analyses on plant capital costs show a significant reduction in cost of the plants beyond Clinch River. Exhibit 12, titled Detailed Plant Costs, compares plant costs of Clinch River with our commercial prototype preliminary design. In the middle column, you see the effect of economy of scale from Clinch River to the next commercial prototype. In the right-hand column, economies are tabulated which can be gained by purely evolutionary improvements from Clinch River. These estimates have been developed by analyzing specifically each of the major systems and are expressed in 1974 dollars. Thirty million dollars of the reduction is associated with equivalent capital cost savings through evolutionary improvements in the fuel cycle. The evolutionary improvements sum up to $125 per Kwe. This is not a major percentage improvement, and I think it is a reasonably conservative number.

Exhibit 13 puts the progression of the LMFBR toward economic parity with the PWR by 1990, portrayed in total plant costs, using a base period for the same dollar value as a plant committed today.

We see a gradual reduction in the subsidy required as we proceed to the larger and more nearly commercial plants, with a resulting four-loop 2000 MWe commercial unit estimated to be within the competitive capital cost band range with a 2000 MWe LWR built in the same time frame.

Questions have been raised as to whether the observed trend of increase in capital costs of light water reactor plants will foreshadow the possibility that these projections of capital cost reductions for the LMFBR are optimistic. First, we believe that the effect associated with escalation and interest on construction will have a small impact on the relative capital costs of major generating systems since each system is subject to varying degrees to the same problems. We see this very picture today in a comparison of the escalating capital costs of large fossil and nuclear power plants. A recent survey carried out on these trends has shown that the overall estimated increase in investment requirements for an 1100 MWe nuclear plant through the 1973–74 period is 42%, while the equivalent increase of a 1000 MWe coal plant is 43%, and a high sulfur oil burning plant at 1000 MWe capacity is 38%. Parenthetically, it should be noted that the increase in fuel costs in both the coal and oil cases have overwhelmingly favored nuclear in the total power costs in these trend estimates.

As for the other effects associated with increased requirements, we believe that we have, at the early stages of the breeder program experienced and included these requirements. In some respects today, we are in fact designing to a more rigorous set of standards than present commercial unclear plants. We judge, therefore, that if anything, the costs associated with these requirements may decrease rather than increase. We do not see a relative increase in LMFBR capital costs as compared to either light water reactor costs or large fossil power plant costs, and thus the economy of scale and learning curve effects will predominate and bring us into the economically acceptable capital investment band (Exhibit 14).

Safety, environmental, safeguards, and waste-management issues

The U.S. LMFBR program is giving major attention to safety, environmental, and safeguards considerations in the design of test facilities and demonstration plants as well as supporting research and development activities. Through our lead role on the Fast Flux Test Facility and the Clinch River Breeder Reactor Plant, Westinghouse is giving these issues top priority in all design work.

The potential safety concerns that must be addressed in the design and operation of an LMFBR nuclear power plant revolve primarily around the chemical activity of the sodium coolant, the necessity for heat removal during plant operation and after reactor shutdown, the effective control of fast power transients, and the use of plutonium as the nuclear fuel.

As is the established practice for all nuclear power plants, LMFBR safety is assured by three distinct levels of protection:

First, by providing a technically sound and reliable plant design based on the use of proven technology; second, by providing protection against anticipated events and unlikely faults with a comprehensive and reliable plant protection system; and third, by designing plant components and systems to accommodate certain extremely unlikely accidents which are never expected to occur during the life of the plant. This basic approach has been made feasible as a result of an extensive background of safety studies and test programs, as well as domestic and foreign fast reactor operating experience.

The safe design of sodium systems is based on experience with sodium as a coolant for some 25 years in reactors and test loops, as well as in many non-nuclear industrial applications. Plant damage from energetic sodium-water reactions is avoided by controls and design features of the use of water in the vicinity of sodium systems. The reactor and primary heat transport system are enclosed in cells inerted with nitrogen to prevent a sodium fire that could occur if the liquid metal came in contact with air. Sodium fire protection systems are provided for the other plant sodium systems where inerting is not feasible.

Adequate cooling of the reactor core during plant operation is assured by the use of multiple cooling loops to provide redundancy in the event of a component failure. Protection against loss of coolant resulting from a leak or rupture in the heat transport system is enhanced in an LMFBR, which has a low system pressure. Conservative design margins, strict quality assurance programs, and use of strong and ductile materials ensure that leaks are highly improballe. Furthermore, an LMFBR can be designed to accept a substantial coolant leak rate without causing significant reactor damage. The reliability of decay heat removal can be maintained at a very high level by means of reundancy in power supplies, water supplies, and heat sinks.

Guard vessels around components will prevent the system from draining, even if leaks do occur, and this assures the ability to cool the core.

Inherent design characteristics, as well as active protective systems, are provided in LMFBR plants to prevent reactor damage from abnormal power transients. The reactor core is designed in such a manner that a negative Doppler coefficient and a negative power coefficient are obtained; these passive design features provide immediate resistance to the progression of a power excursion if such an event ever occurred. Also, a highly reliable redundant reactor shutdown system is provided in an LMFBR to control reactor power and to shut down the plant when required. This system consists of two separate fast-acting control rod subsystems, each capable of accomplishing these functions independent of one another.

In addition to these design features and protective systems for preventing plant damage, multiple barriers are provided to control the potential release of plutonium and fission products to the environment during normal plant operation or unlikely accident conditions. The stainless steel fuel pin cladding and primary coolant system piping provide the first barrier to radioactivity releases. Further obstacles to accidental radioactive discharges to the environment are achieved by massive concrete cells, which house the reactor and primary piping, and an outer steel containment shell.

The effects of construction and operation of any LMFBR power plant on the local environment are no greater than those associated with fossil-fueled and light water reactor (LWR) power plants currently in use. In fact, the higher thermal efficiency of LMFBR plants compared to LWR facilities will reduce the environmental impact associated with dissipation of waste heat from the nuclear component of the nation's future electrical generating capacity. Since the LMFBR utilizes plutonium fuel generated as a by-product of LWR power plants and subsequently breeds its own fuel, it has significant environmental advantages over a fossil-fueled power plant because of insignificant land use requirements.

The safeguards issue concerning an LMFBR power plant is essentially the protection of the plutonium fuel against theft or diversion and protection of the facility against sabotage. The logistical and accessibility problems in obtaining illegal possession of the plutonium fuel in an LMFBR installation with recently upgraded security requirements virtually eliminates the risk of such an event. Similarly, the security clearance that will be required for all plant personnel in sensitive positions, as well as the safety features described above that will protect the plant against accident conditions, will reduce the probability and consequences of sabotage to acceptable levels.

Plutonium is a radioactive material which emits a strongly ionizing alpha particle and is toxic to the human body only when it comes in contact for a significant period of time with internal body tissues. Protection of the public against exposure to this toxic substance essentially consists of limiting the quantity of plutonium entering the human body by inhalation or ingestion. Extensive experimental studies have been made on the behavior of plutonium in biological systems and in the natural environment. These studies have led to the definition of exposure standards which limit intake of plutonium by radiation workers and the general public to safe levels.

On the basis that sufficient information is known about the environmental and biochemical behavior of plutonium to establish reliable limits of human intake of plutonium, development of a plutonium economy to satisfy the nation's energy needs *without* compromising the health and safety of the public, requires that the nuclear industry design and operate its plutonium facilities in conformance with these limits.

Plutonium has been handled and processed in government and commercial facilities in the U.S.A. and many foreign countries for many years. Hundreds of tons of plutonium have been safely shipped, stored, fabricated, and safeguarded over the past 30 years in the weapons program. Independent of the breeder, military applications involving plutonium will continue until it is deemed that we can do without the protection of nuclear weapons.

The exposure of radiation workers to levels of plutonium exceeding permissable limits occurred in the early days of plutonium work, when techniques and facilities were crude relative to those in operation today. Because we have understood much of the toxicological properties of plutonium for decades, we have been able to develop techniques and to design facilities for working safely with this material. None of the plutonium exposures that have occurred to date in government or industrial facilities in the U.S.A. and other foreign countries has been reported to have produced any biological effects that are attributable to plutonium inhalation or deposition, including the 25 U.S.A. workers with exposures of approximately 25 years duration.

The design features and procedural controls applicable to plutonium facilities are continually evolving to reflect the knowledge and experiences gained in current plutonium research and production activities. In this matter, the commercial plutonium industry will continue to improve its effectiveness in handling and processing plutonium in a safe manner.

In the case of the breeder reactor power plant, the plutonium fuel consists of high-fired ceramic pellets of plutonium-uranium dioxide. Not only is this chemical form relatively inert in the natural environment, but the physical form is also most effective in preventing the dispersion of plutonium fuel into the atmosphere. Hence, even in the unlikely event that transportation accidents or fuel handling accidents resulted in direct exposure of the plutonium fuel to the environment, only small and localized contamination would be expected to occur, if at all. While the fuel is installed in the reactor core during operation, the plant is designed such that multiple barriers must be breached or penetrated before the radioactive materials in the fuel could be released to the environment. The first barrier is the fuel material and its stainless steel cladding, which are designed to retain these radioactive materials. As a second independent barrier, the reactor core and the sodium coolant are contained in a high-integrity steel primary system which, in turn, is surrounded by a guard vessel, the third barrier, which serves to prevent the dispersal of any radioactive materials that might be released beyond the confines of the fuel cladding and the primary system components. The fourth barrier is the containment building surrounding the reactor plant. Hence, there is a high degree of confidence that effective containment of plutonium can be achieved in a breeder reactor plant, ensuring public health and safety will not be compromised.

An additional and incresingly important safety consideration in the proposed expansion of the plutonium fuel cycle is the possible theft of plutonium (or other special nuclear materials) by an individual or organized group for purposes of threat or violence. Such a risk arises from the fact that plutonium is a toxic and fissionable material that can be used as an explosive weapon or as a biological poison.

Its toxicity is no greater than that of many more easily available substances, and because plutonium produced in nuclear power reactors is significantly different in composition and emits much more penetrating radiation than military grade plutonium, its use for bomb fabrication is exceedingly difficult and hazardous. However, those critical of breeder reactor development have keyed on the plutonium issue to scare the general public. Certainly an individual bent on terrorism, or blackmail, has at his disposal a multitude of materials and methods much easier and safer to obtain, carry and use.

A person or persons undertaking the tasks of constructing a plutonium explosive weapon without the sophisticated facilities and trained personnel that only a well-financed operation could provide would be seriously jeopardizing his health, if not his life. It should be recognized that there is a fundamental difference between designing a nuclear weapon on paper from available technical literature and converting this design into a workable devise, especially using reactor grade plutonium. The time and effort expended by certain foreign countries, in the past and recently, to achieve nuclear weapon capability in spite of the availability of fissionable material and technical information indicate the complexities involved. The probability appears to be quite remote that an implosion-type weapon could be constructed safely by such a person.

It should be noted that only fine-sized particulates of plutonium with physical diameters less than 10 microns can be airborne and capable of lodging in the lungs, causing potentially significant radiological effects, and inhalation is really the only hazard since the gastrointestinal tract absorbs less than 0.003% of ingested plutonium. Hence, in spite of the toxicity of plutonium, dispersal of breeder reactor fuel material in the environment would most likely present a serious health hazard only in the immediate vicinity of the point of release, where plutonium airborne concentration levels would tend to be high. The quarantine of suspect food supplies and the implementation of established decontamination techniques and procedures would be necessary, but would virtually eliminate the long-term hazards of environmental plutonium contamination that might otherwise persist.

In spite of the increased availability of plutonium that will result from the growth of the commercial LMFBR industry, there are only a few stages in the breeder fuel cycle that are at all potentially vulnerable to acts of theft or sabotage. The current safeguards program effectively focuses on these areas in a manner that is considered adequate. In this regard, the necessary technology exists to establish security systems for substantially reducing the likelihood of obtaining nuclear material for illicit purposes. Much of the concern being expressed recently is based on the vulnerability of previous security measures, no longer valid under the new regulations, and an inadequate appreciation of the technological advancements incorporated in the present safeguards system. Continuous upgrading of current security measures to reflect new technology and experience will ensure that the LMFBR fuel cycle will be adequately protected against nuclear theft or diversion and their associated hazards.

The radioactive waste issue has also received much attention from critics of nuclear power. The radioactive waste from the breeder reactor will be similar in quantity and type to that from present day reactors.

Actually, radioactive waste management is not a new issue. Wastes from the weapons program have been handled safely for the past 30 years. Some minor leaks have occurred in old single-walled carbon steel tanks used for weapons waste, but with no hazard to employees or the general public.

New stainless steel double-walled tanks with leak detection capability and the requirement for solidification in an unleachable form avoids the consequences of tank leakage.

The use of surface interim storage facilities for the solidified waste will allow recovery for ultimate disposal or for presently identified or future beneficial uses. Many beneficial uses exist today for these wastes or their derivatives. Medical applications include use in long-lived cardiac pacemakers and artificial hearts currently under development. They have been used for long-lived remote location power sources—in space and deep beneath the sea, as well as for food preservation. Applications also exist and are now under development for use as low-grade heat sources.

Ultimate disposal of the long-lived waste material in the deep salt beds offers virtually no hazard to the public. The very presence of these salt formations indicates that the area has been geologically stable and free of moisture for millions of years, and indicates also that it will likely remain that way for millions of years to come.

The quantity of solidified radioactive waste from nuclear power generation will not be large. In fact, through the year 2010, we estimate the total volume of waste committed to storage or disposal to be equivalent to a cube about 30 yards on each side.

CONCLUSION

In conclusion, it is an historically proven fact that we will need energy growth to recovery from our currently depressed economy, sustain a healthy economy, and provide jobs in the future. Our present reliance on oil and natural gas must gradually shift to a dependence on electricity produced from our more abundant domestic coal and uranium resources. Present day light water reactors will have to be supplemented with growing numbers of breeder reactors beginning in the 1990s to prevent the severe economic and environmental costs of massive strip mining of low-grade uranium ores, or of being forced to import high-priced foreign uranium. The issues of breeder safety, environmental effects, plutonium safeguards, and radioactive waste management have been given top priority and the solutions to all identified problems are well in hand. The U.S. liquid metal fast breeder reactor program is well along. The need exists, and the economic benefits are great.

If history proves us to be wrong in the projections discussed earlier, and if the U.S. proves to use less energy, rather than more, then the American people will enjoy an energy surplus, with lower prices than if there is a shortage.

But if history proves those who disagree with us to be wrong, and if it proves that the U.S. needs more energy—and if the necessary systems have not been developed to provide that energy, the United States' problem will be one not just of shortage, but of survival.

The risk of being wrong is just too great to take.

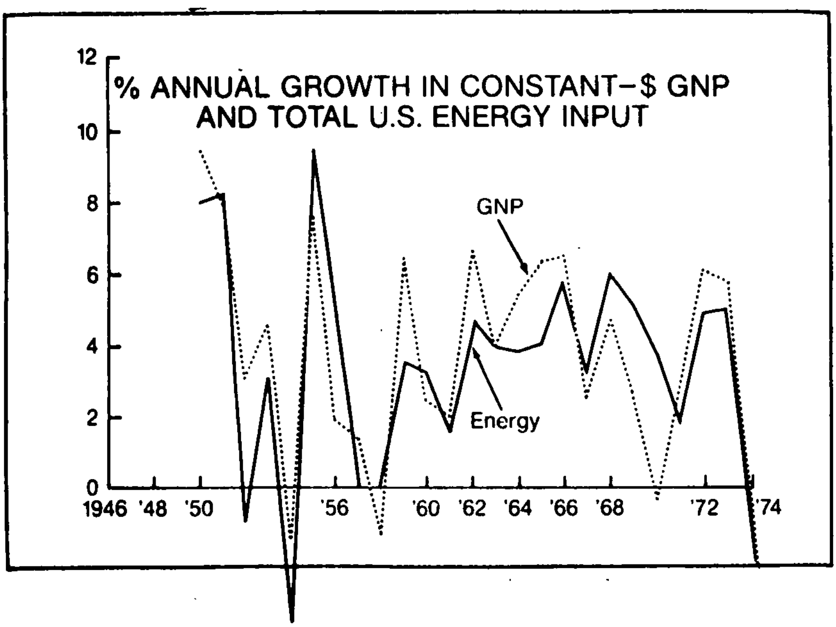
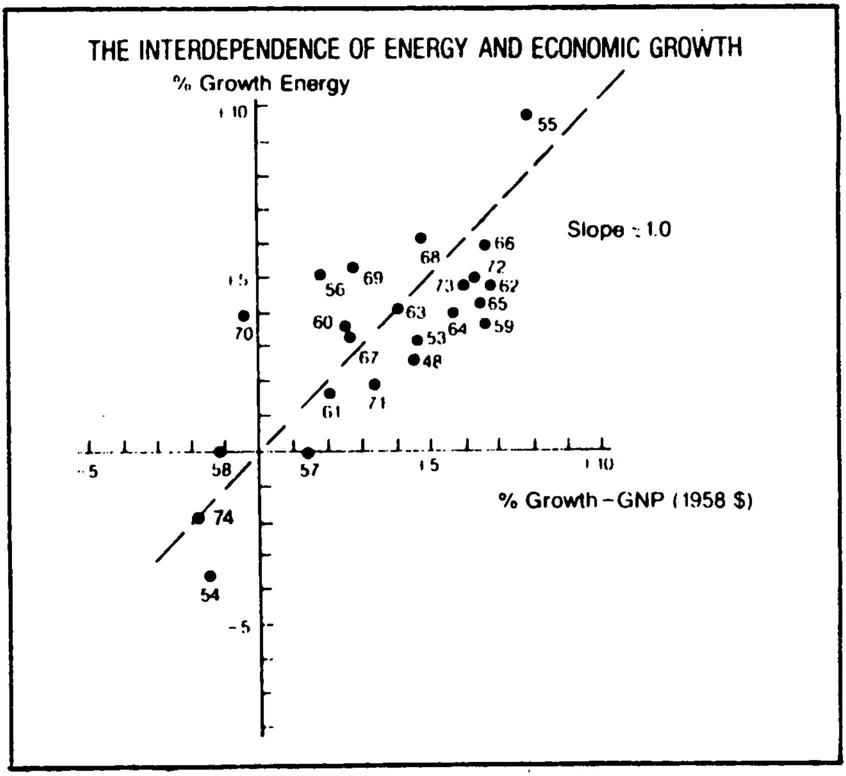


EXHIBIT 1



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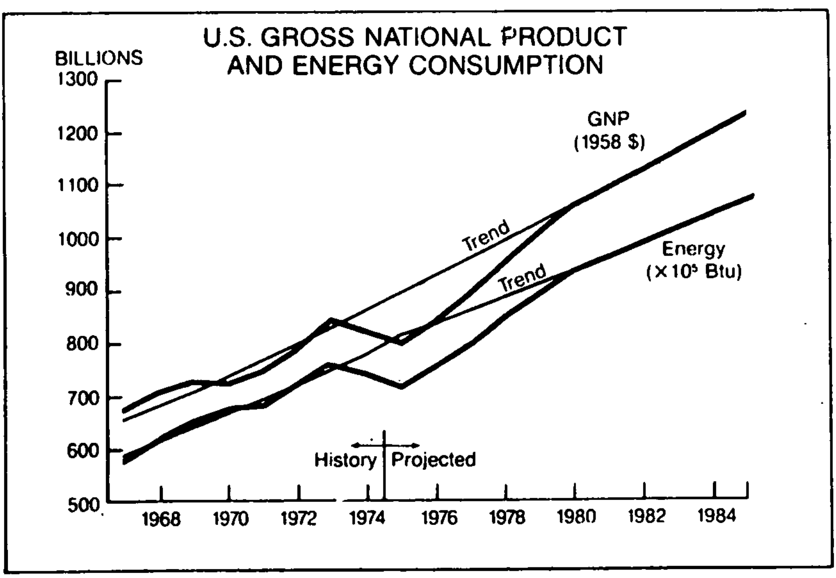

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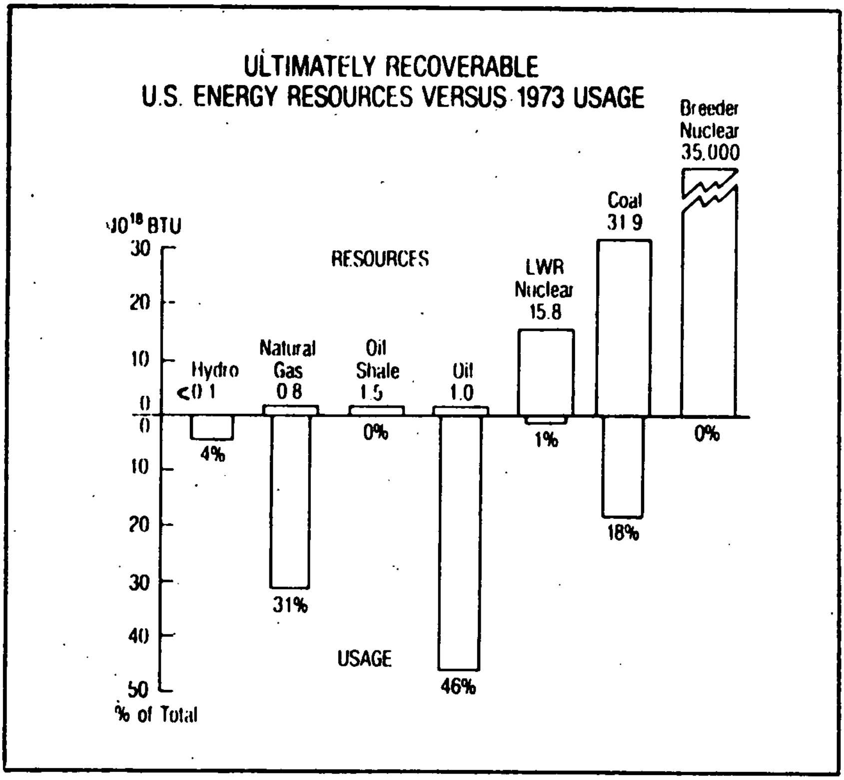

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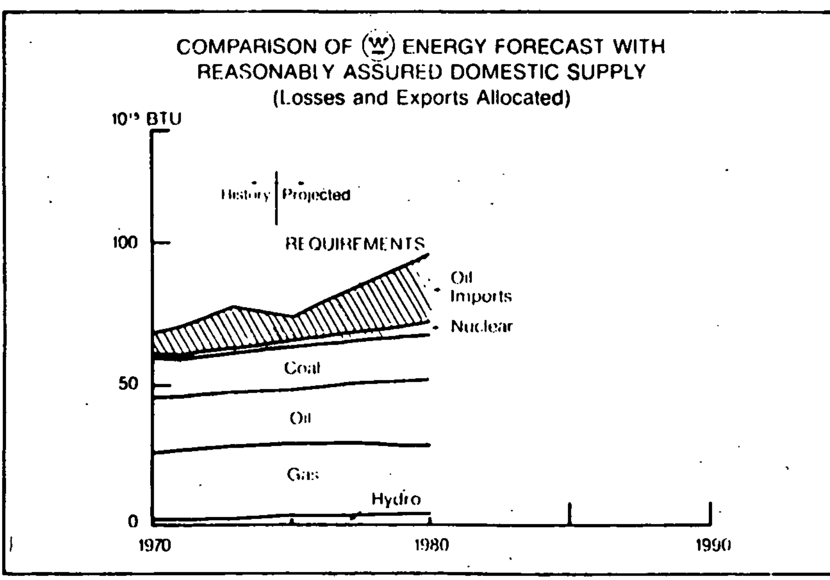

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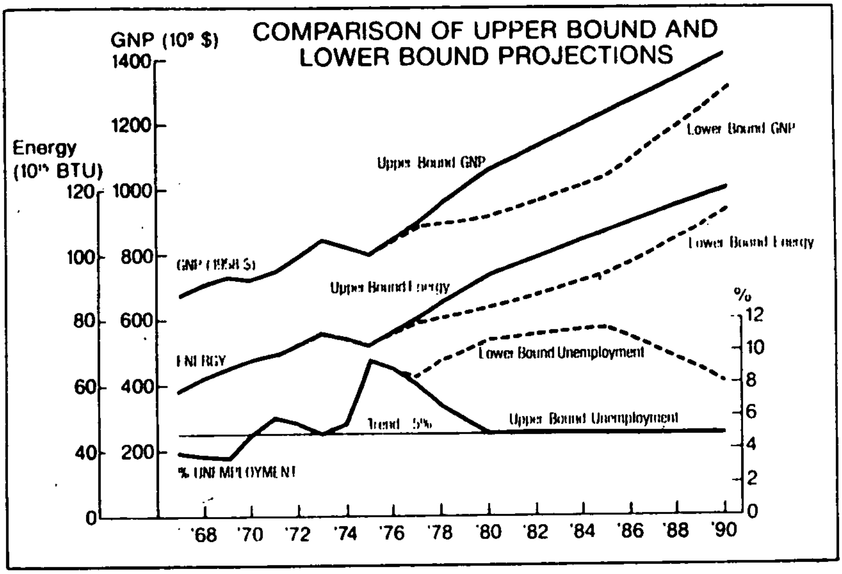

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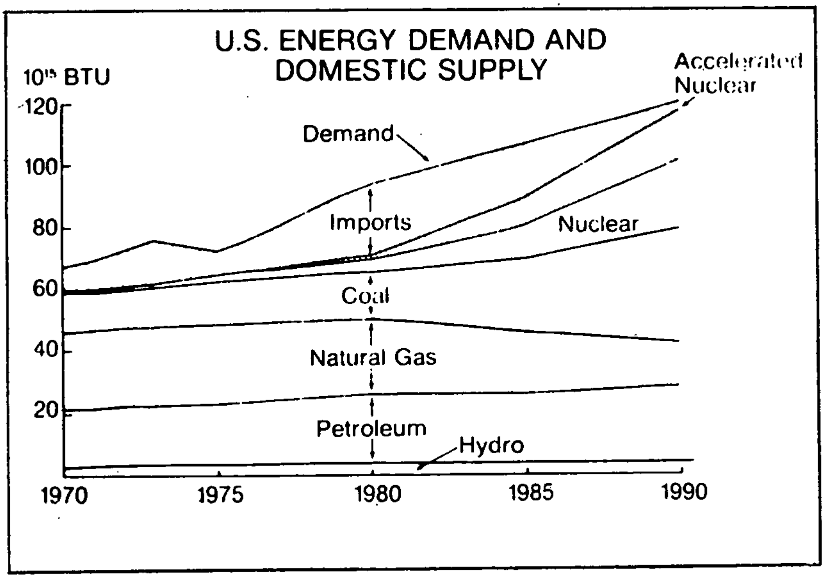


Exhibit 7

RESOURCES AND UTILIZATION COAL AND URANIUM

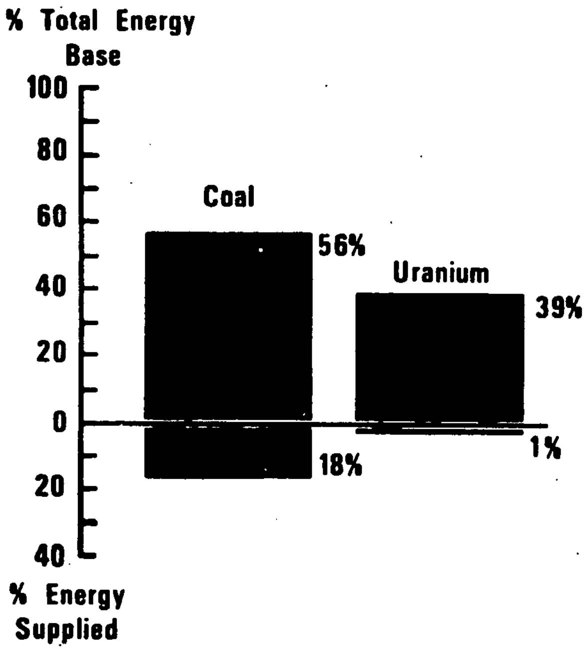


EXHIBIT 8

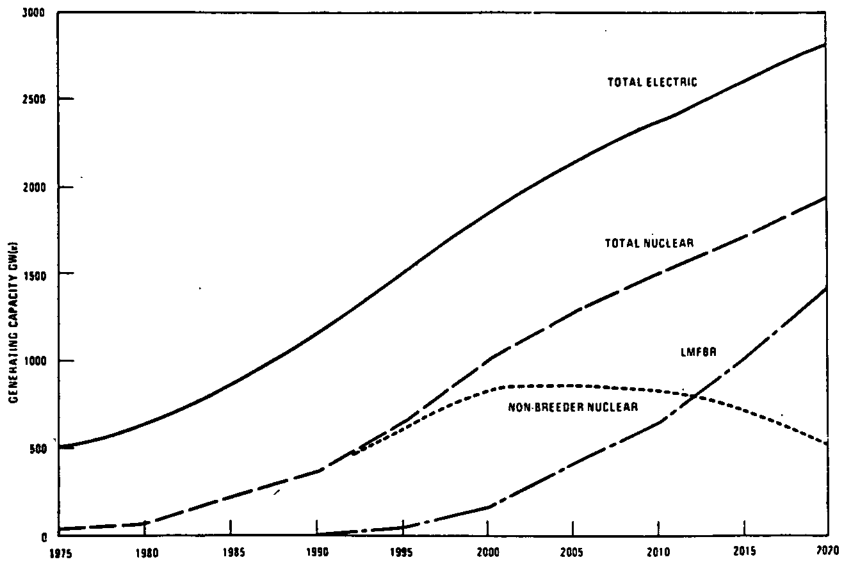


EXHIBIT 9

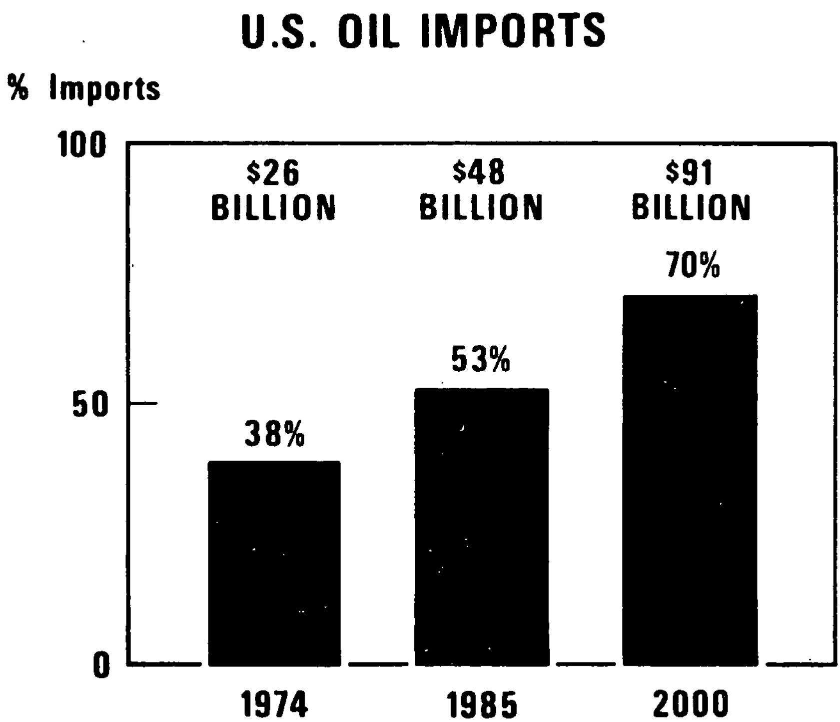

U.S. OIL IMPORTS
% Imports
100
50
0
$26
BILLION
$48
BILLION
$91
BILLION
38%
53%
70%
1974
1985
2000

EXHIBIT 10

DISCOUNTED PRESENT VALUE OF THE BREEDER REACTOR (BENEFITS AND COST)

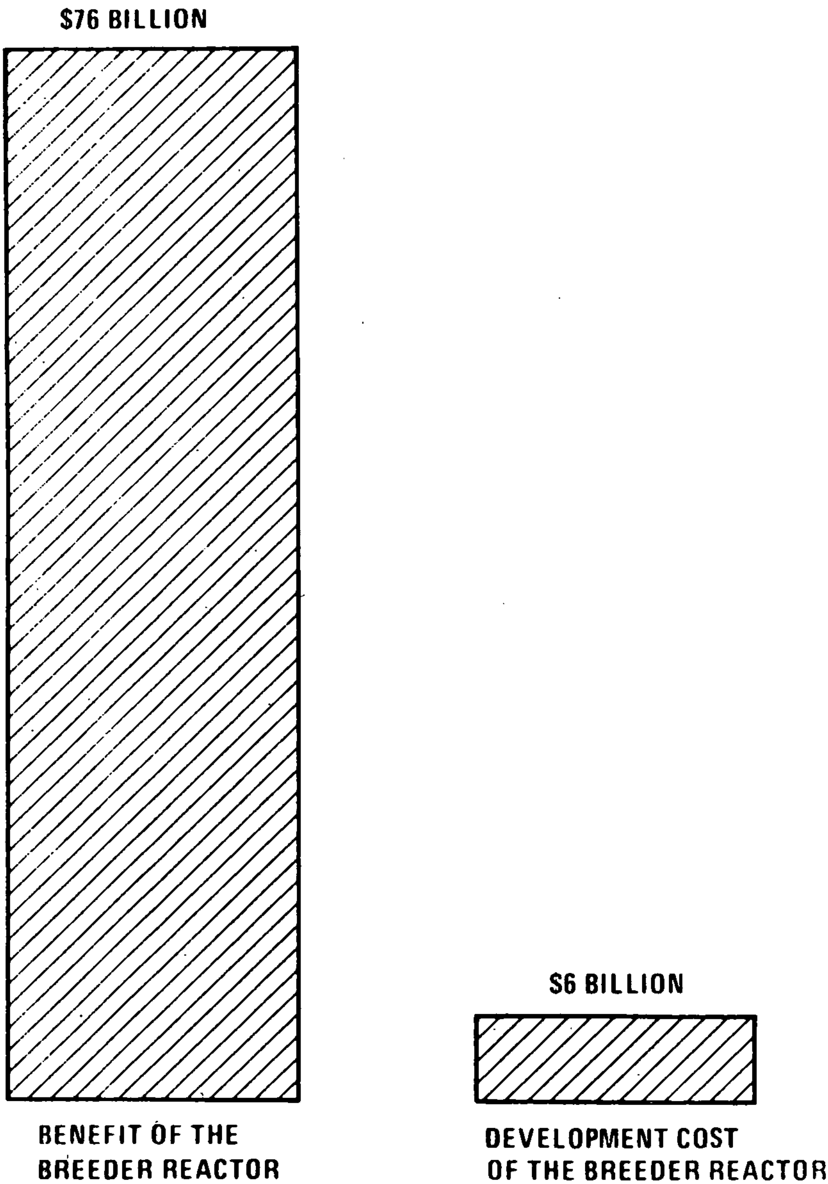


EXHIBIT 11

DETAILED PLANT COSTS
(1974 Millions of Dollars)

		COMMERCIAL PROTOTYPE	
	CRBRP	DIRECT SCALE-UP OF CRBRP	WITH DESIGN IMPROVEMENTS
REACTOR SYSTEMS	183	110	72
HEAT TRANSPORT SYSTEMS	238	330	285
STEAM & FEEDWATER SYSTEM	61	162	162
AUXILIARY SYSTEMS & MAINTENANCE	102	92	69
BUILDINGS	138	140	102
ELECTRICAL	43	63	55
I&C	67	58	50
SUBTOTAL	832	955	795
EQUIVALENT CAPITAL COST DUE TO IMPROVEMENTS IN FUEL CYCLE			
TOTAL	832	955	765
$/KWe		635	510

EXHIBIT 12

PROGRESS IN COST AND RATING OF LMFBR AND COMPARISON WITH PWR PLANT IN 1990

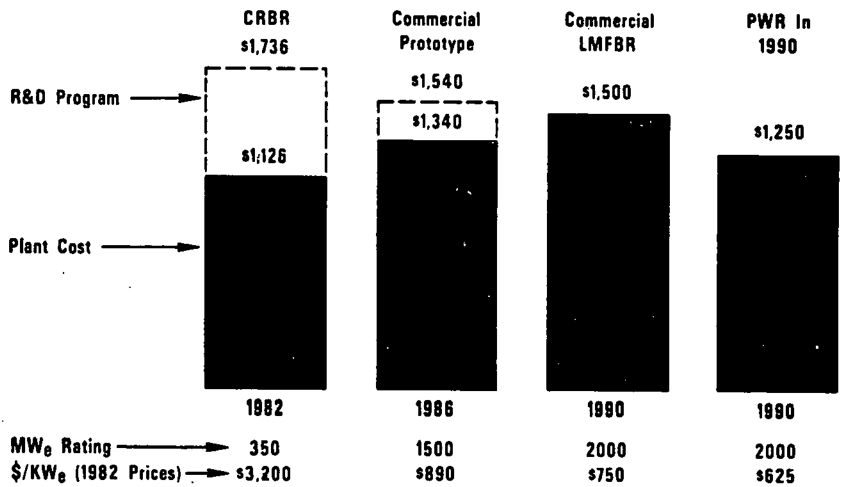


EXHIBIT 13

COST TREND OF NUCLEAR GENERATING STATIONS

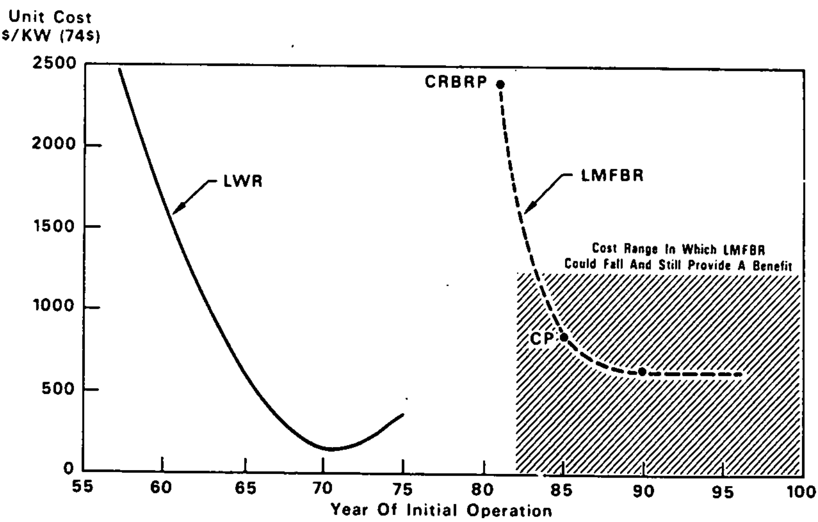


EXHIBIT 14

Chairman HUMPHREY. I think the public can see the difficulty that those of us in the Congress have on some of these matters, because your final summation was very persuasive and yet Mr. Nader said in his testimony, for example—

> In summary, we have to judge the risks of the breeder by our experience with all other technologies. Other technologies, in spite of their promoter's claims, have suffered catastrophes.

Don't misunderstand me, I am not arguing the merit of the case, but to be judge and jury on this is difficult.

Mr. NADER. The Titanic was not loaded with plutonium.

I would like to make one point here clear in this context. If Mr. Simpson was asked a year ago what would be the likelihood of a man with a candle starting a fire in a nuclear reactor which would shut it down for 3 to 6 months and a multimillion-dollar disaster disoperating the emergency core cooling system, I wonder what he would have said?

Mr. SIMPSON. The answer is if you put a candle flame to flammable insulation it will burn.

Mr. NADER. And that is what happened at Brown's Ferry.

Chairman HUMPHREY. All right. This could be really interesting. I am sorry we are running short of time. There is nothing I like better than a good panel discussion.

I am going to bring you back, we have to do it. There are points of view that need to be discussed, and I think the public needs this kind of information.

By the way, public radio is giving the American public this information today which is really a help in understanding this difficult matter.

Mr. Cochran, am I correct that you are somewhat of a critic of the program?

Mr. COCHRAN. Yes; that's correct.

Chairman HUMPHREY. Mr. Cochran, would you proceed, please, and if you would just tighten it up, we could turn you loose on each other for a while.

STATEMENT OF THOMAS B. COCHRAN, STAFF SCIENTIST, NATURAL RESOURCES DEFENSE COUNCIL, INC.

Mr. COCHRAN. Mr. Chairman, members of the committee, thank you for this invitation to testify at these important hearings on the breeder reactor program.

My name is Thomas B. Cochran. I am a staff scientist at Natural Resources Defense Council (NRDC), a nonprofit environmental law firm with offices in Washington, D.C., New York, and Palo Alto. Prior to joining NRDC in 1973, I was a senior research associate at Resources for the Future (RFF) here in Washington, where I wrote "The Liquid Metal Fast Breeder Reactor: An Environmental and Economic Critique." Since 1971 I have been engaged full time following developments in the civilian nuclear power industry, concentrating principally on the Federal Government's liquid metal fast breeder reactor (LMFBR) program.

Since 1967 the LMFBR program has been the Nation's highest priority reactor development program and since 1971 it has been accorded the highest priority among all the Federal Government's energy research and development efforts.

The LMFBR's dominance of the energy research and development scene stands out clearly in recent budget estimates. During the coming fiscal year the new Energy Research and Development Administration—ERDA—plans to spend roughly one-third of its budget for energy R. & D. on this single reactor program, more than the combined allocations for fossil energy development, solar energy development, geothermal energy development, advanced energy research, and energy conservation.

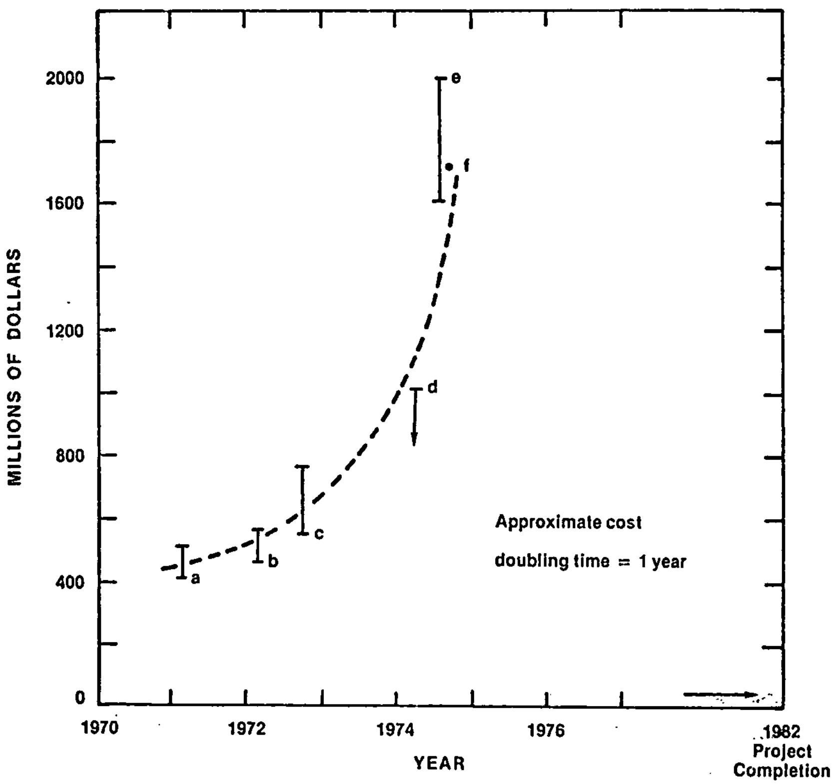
The total cost of developing the LMFBR is now estimated to be $10 billion, and this estimate, made by proponents of the program, must be judged as conservative. The true cost will probably be more nearly twice this amount. Already the LMFBR program has experienced tremendous cost overruns. Two years ago total program costs were put at less than half of today's estimate.

The principal test facility of the program, the fast flux test facility—FFTF—was originally planned to cost $87 million, but the latest estimate is over $1 billion, more than a tenfold increase. Congress was told in 1973 that the proposed Clinch River breeder reactor plant—CRBR—the first LMFBR demonstration plant if one overlooks Fermi-I, would cost $700 million. Today, the estimate is over $1.7 billion. As shown in figure 1, the CRBR has a cost doubling time of 1 year. The sodium pump test facility, when it was authorized in 1966 was estimated to cost $6.8 million. The total cost is now estimated to be $57.5 million.[1] There is no sound reason to believe these trends will not continue.

[Figure 1 follows:]

FIGURE 1

BREEDER REACTOR (COST) DOUBLING TIME



AEC Estimates of the Range in the Cost of the Clinch River Breeder Reactor.

Source: (a) JCAE Hearings, AEC Authorizing Legislation - FY 1972, p. 702.
(b) JCAE Hearings, AEC Authorizing Legislation - FY 1973, pp.1156-1159.
(c) JCAE Hearings, LMFBR Demonstration Plant, Hearings, p.44.
(d) Nucleonics Week, 15, March 21, 1974, p.1.
(e) Weekly Energy Report, 30, July 29, 1974, p.1.
(f) Weekly Energy Report, 38, September 23, 1974, p.6.

[1] Comptroller General of the United States, "The Liquid Metal Fast Breeder Reactor Program—Past, Present, and Future," report to the Congress, ERDA. RED–75–352. Apr. 28, 1975.

Mr. COCHRAN. And it is not just the overruns. There are still hidden costs in the program. Recognizing that the next generation of plants following the CRBR will not be commercially competitive, ERDA has recently restructured the LMFBR program. All but one of the demonstration plants have been eliminated. These have been replaced by a plant component test facility to be followed by a commercial-size called near-commercial breeder reactor—NCBR. What ERDA does not publicize is that it has earmarked only $300 million for the Government's share of the NCBR. Yet a subsidy of at least $1 billion will be required. Can we expect the utilities to absorb this loss? Experience suggests that we cannot. The Federal Government will be the major source of funding for the project, just as it has to fund the CRBR.

The fundamental question now before the Congress and ERDA is whether the breeder program deserves priority attention and great commitment of present and future resources. In my judgment it does not—not only because of the environmental and safety concerns, but on the basis of economic considerations alone.

In my view the present LMFBR program with its high priority cannot be economically justified at this time. The basis for this view is contained in "Bypassing the Breeder: A Report on Misplaced Federal Energy Priorities," and reviews of cost-benefit analyses performed by other organizations. "Bypassing the Breeder" was prepared just over a month ago by Mr. J. Gustave Speth, Mr. Arthur R. Tamplin, both on the NRDC staff, and myself.

Mr. Chairman, with your permission, I would like to submit this report and the accompanying appendix for the record.

Now, may I take this opportunity to review the economic issues detailed in the report?

Chairman HUMPHREY. Yes; if you will present the report and appendix we will include it at the end of your testimony.

Mr. COCHRAN. The breeder economic issue is an issue of timing. When will the higher fuel cost of today's reactors offset the higher capital cost of the breeder? In addressing the LMFBR timing issue it is important to understand that the issue has nothing to do with blackouts or brownouts or the exhaustion of uranium fuel for the current generation of nuclear reactors.

The breeder may ultimately promise to be cheaper because of its very low uranium cost per unit energy. But fuel costs represent only a small fraction of the cost of electricity from nuclear reactors. An increase in the price of uranium fourfold—from today's $20 a pound U_3O_8 price—would only lead to a 3.5 mill per kilowalthour electricity cost increase. This is roughly equivalent to a $2 per barrel increase in the price of oil. This is quite modest for a power-supply system in which costs have increased from 4 mills per kilowatthour to 20 mills per kilowatthour, in less than 10 years for reasons which have nothing to do with uranium prices.[2]

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[2] Bupp, Irvin C., and Jean-Claude Derian, "The Breeder Reactor in the United States: A New Economic Analysis," Technology Review, July/August 1974, p. 26.

Chairman HUMPHREY. I believe what you have said here is that the basic economic issue is the issue of timing, is that correct?

Mr. COCHRAN. That's correct.

Nuclear power may be abandoned for any number of reasons, but it is in no danger of losing out to other fuels because of higher uranium prices. As Prof. David Rose of MIT notes—

> Economic introduction of the LMFBR at the turn of the century would be a sign of technological good fortune, not resolving an energy crisis with a time limit.[3]

The Atomic Energy Commission has now written and released three cost-benefit analyses of the LMFBR program.[4] In addition to the AEC's analyses, cost-benefit analyses of the breeder program have been performed by Alan S. Manne and Oliver S. Yu,[5] Richard Richels,[6] T. R. Stauffer, H. L. Wyckoff, and R. S. Palmer.[7] In addition, Irvin C. Bupp and Jean-Claude Derian have made an economic evaluation of the breeder program.[8]

All of the cost-benefit analyses, including ours, depend critically upon the accuracy of assumptions regarding (*a*) the choice of the discount rate; (*b*) the cost of the breeder research and development program; (*c*) the capital cost difference between LMFBR's and conventional nuclear reactors; (*d*) the future demand for electricity; and (*e*) the domestic supply of uranium.

It is clear from a review of the economic analyses that have been performed on the breeder that the critical input assumptions can be juggled to come up with widely varying LMFBR cost and benefits. A tempting and too easy way out is to point ot these varying conclusions and dismiss economic analysis on that basis. Yet the basic arguments for the current LMFBR program are economic, and it is

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[3] Rose, David J., "Nuclear Electric Power," Science, vol. 184, No. 4134, Apr. 19, 1974, p. 357.

[4] The first, written in 1968, was released in 1969; an updated (1970) analysis was released in May 1972; and the latest (1973) analysis appeared first in the AEC's draft and then with revisions in the proposed final environmental impact statement on the LMFBR program. [Cited herein as PFEIS, LMFBR.]

[5] Manne, Alan S., and Oliver S. Yu, "Breeder Benefits and Uranium Availability," Nuclear News, January 1975, p. 46. Manne is a professor of political economy at Harvard's JFK School of Government and Yu is on the technical staff of the Electric Power Research Institute (EPRI).

[6] Richels, Richard, "The LMFBR Timing Issue" (draft), March 1975. Richels is a graduate student under Manne at Harvard.

[7] Stauffer, T. R., Wyckoff, H. L., and R. S. Palmer, "The Liquid Metal Fast Breeder Reactor, Assessment of Economic Incentives," presented to Breeder Reactor Corp. (Chicago, Ill.), Mar. 7, 1975. Stauffer is a research fellow at Harvard, Wyckoff is with Commonwealth Edison. and Palmer is manager, business and product planning, in the fast breeder reactor department of General Electric Corp.

[8] Bupp. Irvin C., and Jean-Claude Derian, op. cit. Bupp is in the Center for International Affairs, Graduate School of Business Administration, Harvard, and Derian is at the Center for Policy Alternatives, MIT.

essential that Congress look critically into these economic analyses to determine whose assumptions are in fact reasonable.

In order to appreciate the degree to which the economic analyses of the LMFBR prepared by the AEC and the nuclear industry suffer from a fatal promotional bias, one need only look at the electrical energy growth projection used by the AEC in its most recent analysis. The steepness of the growth curve, as depicted in figure 2 provided by the AEC, staggers the imagination. Today is the first time ERDA has ever admitted that the electrical demand growth rate assumptions were too high by a factor of 50 percent. I am just happy to see that ERDA now recognizes these to be unrealistic.

[See figure 2, p. 464.]

Mr. COCHRAN. A second area where the AEC resorted to unsupportable assumptions to justify the program is the issue of capital cost differences between LMFBR's and present-day reactors. It is possible to accelerate the date when breeders become economically competitive by arguing that as more breeder reactors are sold the unit price will be reduced. Economists refer to this possibility of decreasing costs with increasing number of units produced as "learning." Hence, a central issue is whether it is appropriate to apply a learning curve to the capital cost of LMFBR.[9] The AEC in its latest cost-benefit analysis applied a sharp learning curve to the breeder reducing its capital cost to parity with light water reactors in the short 13-year period following commercial introduction. Remarkably, light-water reactors are assumed not to experience any learning at all. There is really no justification for this approach. The AEC has been predicting a learning curve in the cost of present day nuclear plants for the past decade. To the contrary, the cost of commercial nuclear plants has been increasing at an alarming rate, even in constant dollars. They have been increasing in such magnitude that the effect on the price of electricity is even greater than the uranium price.

So, in fact, there is no justification for assuming learning for either reactor type. Moreover, if a learning effect is ever experienced, it will be felt by light-water reactors before it is felt by breeders. This would increase the capital cost difference between breeders and existing reactors and shift the date of LMFBR commercialization further into the future.

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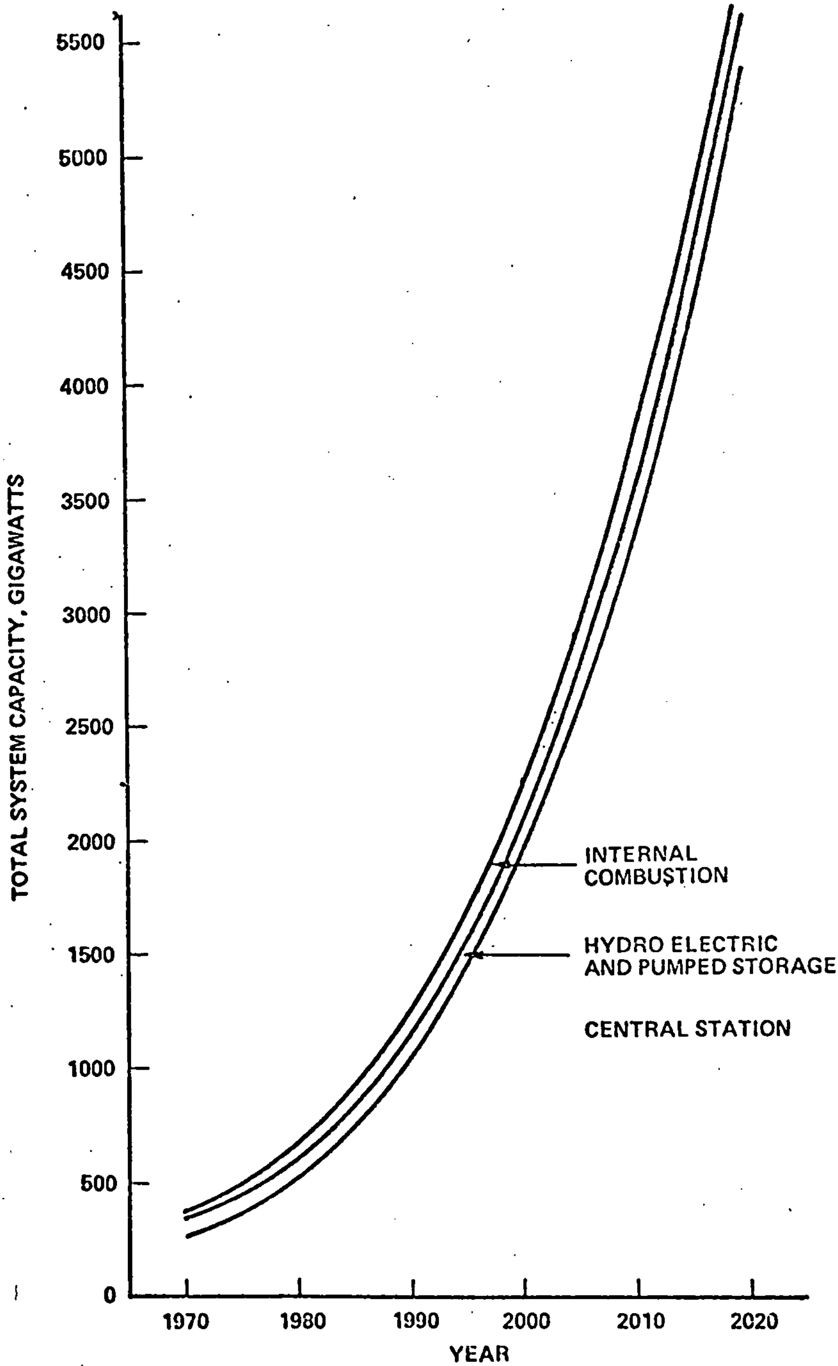
[9] This learning effect is separate from the subsidies associated with first-of-a-kind or prototype plants. The AEC has simply ignored these first-of-a-kind costs.

FIGURE 2



PROJECTED DEMAND FOR ELECTRICAL GENERATING CAPACITY 1970-2020

Source: AEC, proposed final environmental impact statement for LMFBR program (December 1974), vol. IV, p. 9.1–3.

Mr. COCHRAN. What makes the AEC's LMFBR learning curve even more unbelievable is that in the same short period, 1987–2000, when LMFBR capital costs are rapidly falling due to learning there is a shift to an advanced LMFBR design in 1991 and again in 1995. Furthermore, in 1990 plant unit sizes increase from 1,300 MW to 2,000 MW with an additional 12-percent decrease in price.

As mentioned earlier, one of the critical input assumptions is the domestic supply of uranium. A number of independent investigators, including Prof. John Holdren[10] at the University of California-Berkeley, Prof. David Rose[11] at MIT, Drs. Irvin Bupp and Jean-Claude Derian[12] at Harvard and MIT respectively, and Milton Searl,[13] Director of the energy supply studies program at the Electric Power Research Institute EPRI—believe the AEC has been overly conservative in estimating the domestic supply of uranium. The Environmental Protection Agency in its review of the AEC analysis stated that, "the uranium supply could be significantly greater than that projected for the AEC's base case."[14] In our cost-benefit analysis we use a uranium supply curve that is more consistent with the EPRI estimate.

We believe that if the Congress undertakes a careful analysis of all the critical input assumptions it will come to share our conclusion that the LMFBR will not be commercially competitive with existing energy sources until one or two decades after the turn of the century. This is somewhat longer than EPA's estimate of about 4 to 12 years. Yet the current LMFBR effort is aimed at having the new reactor developed by 1990, more than two decades before it could be economically attractive.

In our view the LMFBR program is thus quite premature and could be delayed substantially without incurring any risks relative to meeting future U.S. energy needs. The sense of urgency and crisis that program supporters have promoted to garner support for the LMFBR has no foundation in fact.

Chairman HUMPHREY. So, really, the point that you are making here is the question is, not one of whether we have a breeder, but one of its scheduled introduction.

Mr. COCHRAN. I think the question of whether we have a breeder is a fair question on the basis of its social costs.

Chairman HUMPHREY. I am putting it on the basis of the electrical demand.

Mr. COCHRAN. If you focus narrowly on economics without internalizing the social costs. I believe the issue is one of timing.

Chairman HUMPHREY. Yes; but it isn't the only issue, as I understand it.

Mr. COCHRAN. That's right. On simple economic grounds the push to develop the LMFBR can and should be postponed. Moreover, such a delay would provide the time needed to show what many experts now believe to be the case—that environmentally preferable, nonfission energy options can be made available in time to eliminate the need for

[10] Holdren, John P., "Uranium Availability and the Breeder Decision," Environmental Quality Laboratory, California Institute of Technology, 1973. EQL Memorandum No. 8, January 1974.

[11] Rose, David J., op. cit.

[12] Bupp, Irvin C., and Jean-Claude Derian, op. cit.

[13] Searl, Milton F., "Uranium Resources To Meet Long-Term Uranium Requirements." Electric Power Research Institute (EPRI), EPRI SR–5 Special Report, November 1974.

[14] Environmental Protection Agency, "Comments on Proposed Final Environmental Statement, Liquid Metal Fast Breeder Reactor Program," PF–AEC–A00106–00, p. 3. April 1975.

the LMFBR altogether. What is proposed here is an energy program which should be able to provide an adequate supply of fuels and electric power without the commercial utilization of breeder reactors.

An intensive effort to develop the various forms of solar energy should be undertaken following the recommendations of the expert panels convened under National Science Foundation auspices, "An Assessment of Solar Energy as a National Energy Resource"—1972—and "Solar and Other Energy Sources: Subpanel IX Report"—1973.[15]

Mr. Chairman, of course, you recognize this through your efforts in trying to accelerate the R. & D. work in this area.

In estimates which it believed were not the highest possible, the first of these studies concluded that its recommended R. & D. program could result by the year 2020 in solar energy providing 35 percent of the Nation's total building heating and cooling load, 30 percent of the Nation's gaseous fuel, 10 percent of its liquid fuel, and—most important for present purposes—20 percent of the electrical energy requirements.[16]

Chairman HUMPHREY. We are going to be watching very carefully the economic inputs by the Government in the solar energy program. I felt the Government has been dragging its feet on this matter consistently, and I have been watching to see what ERDA is going to do about it because of its basic AEC structure. When the AEC became ERDA, it had the predominance. Those of us who are interested in solar energy are going to be watching it very carefully.

Mr. COCHRAN. A major R. & D. effort devoted to exploitation of geothermal resources for electric generation should be launched. The Cornell Workshop on Energy and the Environment—1972—concluded that: "It appears that geothermal energy alone is capable of meeting all American power requirements for several centuries if the hot dry rocks resource proves to be practical." [17] The Cornell Workshop, the National Science Foundation, and others have recommended that a program to establish the feasibility of hot rock geothermal in the next few years be given highest priority. Projections of the electric power available from geothermal resources range from 80 to 400 GWe in the year 2000, depending on assumptions made about the hot rock potential.[18] The AEC recently estimated that geothermal heat could supply 6 percent of our electricity in the year 2020,[19] but it is clear that the percentage could be much higher if hot rock geothermal develops as expected.

The current effort to develop fusion power should be expanded. The AEC recently state that: "A successful, vigorously supported fusion program would be expected to lead to construction of a demonstration power reactor that would begin operation in the mid-1990's." [20]

The agency anticipated "commercial introduction of fusion powerplants on a significant scale beginning in the early 21st century." [21]

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[15] NSF/NASA Solar Energy Panel, "An Assessment of Solar Energy as a National Energy Resource," National Science Foundation, Washington, D.C., December 1972; Alfred J. Eggers, et al., "Subpanel IX Report: Solar and Other Energy Resources," National Science Foundation, Oct. 27, 1973.

[16] "An Assessment of Solar Energy," ibid.

[17] "Cornell Workshop on Energy and the Environment, Summary Report," Committee on Interior and Insular Affairs, U.S. Senate, May 1972, pp. 114–115.

[18] See, e.g., Walter J. Hickel, et al., "Geothermal Energy," NSF/RANN–73–003, University of Alaska, 1973, p. 7; Dixy Lee Ray, Chairman, AEC, "The Nation's Energy Future: A Report Submitted to President Richard M. Nixon" (1973).

[19] PFEIS, LMFBR, vol. IV, p. 11.1–20.

[20] PFEIS, LMFBR, vol. III, p. 6A.1–191.

[21] PFEIS, LMFBR, vol. III, p. 6A.1–179.

Thus, it now appears that the demonstration fusion powerplant is not far behind the LMFBR demonstration plant and that fusion plants can be available commercially for much of the period during which it was assumed the LMFBR would be critically needed.

Chairman HUMPHEY. We have negotiated with the Soviet Union in a major effort on cooperation on fusion plant development.

Mr. SIMPSON. The basic U.S. effort was started in cooperation with the Russians and has extended and improved since that time. There is very close cooperation.

Chairman HUMPHREY. I suggest we reduce our defense expenditures about 10 percent each year and put it into fusion. We may do a whole lot more for the world than what we are presently doing. I mean that very seriously.

Mr. COCHRAN. The AEC's overall estimate is that by the year 2020, about 8 percent of our electricity could come from fusion.[22]

Organic wastes provide another source of energy that should be developed. Organic wastes could account for 5 percent of the demand for electricity in the year 2000 but only 2 percent in 2020 due to more efficient practices in the solid wastes area.[23]

Chairman HUMPHREY. For waste disposal in this country, we ought to be activating our R. & D. in this area. There are some cities already using waste as a source of energy.

Mr. COCHRAN. Yes; organic waste could account for 5 percent of the demand for electricity in the year 2000, and in my estimation that is more than we will ever see from a breeder reactor.

All of the above year 2020 percentage contributions—for example, 20 percent for solar, 6 percent for geothermal, et cetera—are based upon the AEC's year 2020 energy demand forecast which assumes a continuation of extremely rapid growth in electricity demand.

Several studies of the future demand for electricity have been carried out using more sophisticated forecasting techniques and taking into account the effects of the increasing price of electricity and other market factors. These studies suggest that actual future demand will be less than half of that projected by the AEC.[24]

Moreover, as a supplement to market influences, it is apparent that the United States is moving toward a national energy conservation policy along the lines recently suggested by the House Committee on Science and Astronautics, the Council on Environmental Quality, the Ford Foundation energy policy project, and others.[25] These groups all suggest that U.S. energy growth can be roughly halved without serious adverse repercussions on the American economy or lifestyle. When both market and policy influences are taken into account, we believe it is reasonable—in fact, conservative—to assume that electricity demand in the year 2020 will not exceed 50 percent of the AEC's astronomical projection. I think we ought to stress that energy conservation is perhaps our best energy resource right now.

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[22] PFEIS, LMFBR, vol. IV, p. 11.1–22.

[23] PFEIS, LMFBR, vol. IV, p. 11.1–21.

[24] The electricity demand issue is discussed in detail in the appendix to "Bypassing the Breeder," pp. 21–28; and in NRDC, "Comments on Draft LMFBR EIS, Alternative Technology Options," PFEIS, LMFBR, vol. VI.

[25] "Conservation and Efficient Use of Energy," report of the Committee on Science and Astronautics, U.S. House of Representatives, Dec. 18, 1974; Council on Environmental Quality, "The Half-and-Half Plan for Energy Conservation," printed in fifth annual report of the Council on Environmental Quality (1974), p. 475; energy policy project of the Ford Foundation, "A Time To Choose" (1974), chs. 3–6.

Mr. Simpson mentioned in his scenario that he could achieve a 10-percent reduction in demand by the year 2000. The Office of Energy Preparedness said it could achieve a 25-percent reduction from his old historical growth rates. The Ford Foundation said 36 percent by the year 2000. Council on Environmental Quality said 35 percent. Environmental Protection Agency says 30 percent by 1990. Federal Energy Administration says 30 percent by the year 2000. "The Nation's Energy Future," which is an AEC report, says 20 percent by the year 2000, at least. The Office of Planning and Analysis of the AEC said 30 percent by the year 2000.

Chairman HUMPHREY. That is as a result of conservation?

Mr. COCHRAN. Yes, conservation alone.

As summarized in the attached table, these estimates of the potential contribution of solar, geothermal, and fusion energy together with energy conservation measures indicate that these sources alone can more than account for the energy expected from the LMFBR in the year 2020, when the reactor is projected to have maximum impact. Indeed, they can account for the energy expected from all fission reactors at that time.

[The attached table follows:]

ENERGY SOURCES FOR ELECTRICITY PRODUCTION IN THE YEAR 2020 WITHOUT THE BREEDER

	Trillions of kilowatt-hours	Percent of AEC projection	Source
AEC projection	27.6	100	([1]).
New energy sources:			
Solar	5.5	20	([2]).
Geothermal	1.7	6	([3]).
Fusion	2.2	8	([4]).
Organic Wastes	.6	2	([5]).
Total	10.0	36	
Correction for market factors and energy conservation	13.8	50	
Total accounted for	23.8	86	
Remainder for other sources (principally fossil fuels)	3.8	14	

[1] Proposed final EIS for LMFBR program vol. IV p. 11.1-25.
[2] NSF/NASA "Solar Energy as a National Resource" (1972) p. 5. Proposed final EIS for LMFBR proram vol. IV p. 11.1-19
[3] Proposed final EIS for LMFBR program vol. IV p. 11.1-20.
[4] Proposed final EIS for LMFBR program vol. IV p. 11.1-22.
[5] Proposed final EIS for LMFBR program vol. IV p. 11.1-21.

Mr. COCHRAN. These considerations indicate that a major LMFBR effort is not needed now and probably never will be. And the risks of continuing the present drive to commercialize the LMFBR are great. The most serious danger is that the LMFBR program will proceed as now planned, consuming the $10 billion presently estimated, and we estimate that number should be double, and plenty more besides, cutting deeply into energy R. & D. funds and holding back the development of the preferable nonfission technologies. Then, having spent enormous sums, the country will find itself with a reactor which must eventually be used only because of the great public and private investments in it and our failure to have developed appropriate alternatives. Our error will be compounded because any attempt to deploy the LMFBR would raise the energy-environment confrontation to an unprecedented intensity.

The last refuge of the breeder proponent is the argument that the LMFBR is needed as an "insurance policy." I do not share this view.

Ample insurance exists partly in pursuing a variety of nonconventional energy sources and energy conservation, and partly in realizing that the AEC would insure us against a nonexistent risk—the risk that our electrical-generating capacity will actually grow as that agency projected.

Furthermore, the insurance argument cuts both ways. While proponents of nuclear power wish to insure against the depletion of low cost uranium, opponents wish to insure against catastrophic breeder accidents, nuclear terror, and blackmail. We can purchase both policies by continuing much of the LMFBR base program R. & D. and the LMFBR safety research, gathering operating experience with the fast flux test facility, but relegating the overall program to a low-priority status by foregoing any expensive push toward demonstration and commercial reactors.

At the same time we could accelerate the development of attractive nonfission alternatives such as solar, geothermal, fusion, and energy conservation.

During the intervening years while the commercial component of the LMFBR program is delayed, much can be learned about uranium availability, future energy demand, and about LMFBR's component development from foreign programs. Furthermore, postponing the commercial component of the LMFBR program one to two decades does not permanently eliminate the LMFBR option, although I would consider this a last resort type of option. If within about a decade it becomes clear that possible nonfission options are not going to be available, consideration can be given at that time to reinitiating the full program. One could proceed with the CRBR or more probably would proceed with a demonstration plant of another size and a different design, and possibly with a different management and cost-sharing structure. There would be no penalty for such postponement.

I might add, Mr. Thorne just stated, if there is no utility interest in the near-commercial breeder reactor, the Government will not pursue this program any further. In the ERDA budget right now there is $300 million earmarked for that reactor. It is going to be also a first of a kind reactor and it is going to be more costly than the Clinch River reactor. It is three to four times larger. It will require enormous subsidies. These subsidies are not in the ERDA budget. Unless we are going to have some more cost overruns, these subsidies will be coming from the utilities.

If you look at the LMFBR program schedule, the financing of this near-commercial breeder reactor is supposed to occur in about 2 years—in 1977. We just heard that EPA believes the program can be delayed 4 to 12 years. We personally believe it can be delayed somewhat longer. We can certainly delay it and find out whether this utility commitment is really here with respect to the near-commercial breeder reactor. If it is not here, there is no sense in going ahead with the Clinch River reactor.

So I would propose that at the very minimum we delay the Clinch River breeder reactor until we find out if there is really any interest in the utilities funding this program.

Chairman HUMPHREY. We thank you very much, Mr. Cochran. It is very helpful testimony. Your report and the appendix will be printed in the hearing record at this point.

[The report and appendix follow:]

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Bypassing the Breeder

A Report on Misplaced Federal Energy Priorities

By

Thomas B. Cochran
J. Gustave Speth
Arthur R. Tamplin

March, 1975

At a time of soaring power costs, federal energy officials are giving prime attention to the development of a new nuclear power source which for the next thirty years or longer will not be able to produce electricity as cheaply as existing sources.

At a time when the wisdom of a national commitment to nuclear fission power is increasingly doubted, federal energy policy is according highest priority to the development of a new type of fission reactor which promises to be even more hazardous and problematic than today's reactors.

At a time when new non-fission energy alternatives, including solar, geothermal and fusion energy, are poised for major breakthroughs, federal energy funding is heavily weighted towards a nuclear development program which is experiencing cost overruns of such magnitude that they will severely restrict the funding available for these alternatives.

Such disquieting ironies are the trademark of the federal government's program to develop the Liquid Metal Fast Breeder Reactor (LMFBR). Raised to preeminence by a President who later confessed that "all this business about breeder reactors and nuclear energy is over my head,"[1] the LMFBR has been oversold by its proponents to the point that it is now one of the great white elephants of the day.

The LMFBR's dominance of the energy research and development scene stands out clearly in recent budget estimates. During the coming fiscal year the new Energy Research and Development Agency

(ERDA) plans to spend $1.66 billion on direct energy R&D. Of this amount, over $490 million is to be spent on the LMFBR program. This is roughly a third of ERDA's budget for energy R&D and more than the combined allocations to fossil energy development ($311 million), solar energy development ($57 million), geothermal energy development ($28 million), advanced energy research ($23 million) and energy conservation ($32 million).[2]

The total cost of developing the LMFBR is now estimated to be $10 billion,[3] and this estimate, made by proponents of the program, must be judged as conservative. Already the LMFBR program has experienced tremendous cost overruns. Two years ago total program costs were put at less than half of today's estimate.[4] The principal test facility of the program, the Fast Flux Test Facility (FFTF) was originally planned to cost $87 million, but the latest estimate is $933 million, more than a tenfold increase.[5] Congress was told in 1973 that the proposed Clinch River Breeder Reactor Plant (CRBRP), the first LMFBR demonstration plant if one overlooks Fermi-I,* would cost $700 million. Today, the estimate is over $1.7 billion.[6] There is no sound reason to believe these trends will not continue.

These figures indicate at a minimum that the LMFBR program could cost the American taxpayer a very substantial sum. It would be reassuring if such expenditures could be justified, but they cannot. Unfortunately, the LMFBR program is neither needed nor desirable, for several reasons.

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*/ Fermi-I, the first commercial LMFBR plant, experienced a partial core meltdown and has subsequently been shut down.

First, economic analysis of the potential of the LMFBR[7] indicates that, contrary to Atomic Energy Commission expectations, the new reactor cannot be commercially competitive with existing energy sources until after the year 2010. Yet the current LMFBR effort is aimed at having the new reactor developed by 1990, more than two decades before it could be economically attractive. The LMFBR program is thus quite premature and could be delayed substantially without incurring any risks relative to meeting future U.S. energy needs. The sense of urgency and crisis that program supporters have promoted to garner support for the LMFBR has no foundation in fact.

On simple economic grounds, then, the push to develop the LMFBR should be postponed. Moreover, such a delay would provide the time needed to show what many experts now believe to be the case -- that environmentally preferable, non-fission energy options can be made available in time to eliminate the need for the LMFBR altogether. Recent estimates of the potential contribution of solar, geothermal and fusion energy together with energy conservation measures indicate that these sources alone can more than account for the energy expected from the LMFBR in the year 2020, when the reactor is projected to have maximum impact. Indeed, they can account for the energy expected from all fission reactors at that time.[8]

These considerations indicate that a major LMFBR effort is not needed now and perhaps never will be. And the risks of continuing the present drive to commercialize the LMFBR are great. The most serious danger is that the LMFBR program will proceed as now planned, consuming the $10 billion presently estimated and plenty more besides, cutting deeply into energy R&D funds, and holding back the development of the preferable non-fission technologies. Then, having spent enormous sums the country will find itself with a reactor which must eventually be used only because of the great public and private investments in it and our failure to have developed appropriate alternatives. Our error will be compounded because any attempt to deploy the LMFBR widely would raise the energy-environment confrontation ~~to an~~ unprecedented intensity.

Our recommendation in light of these conclusions is that ERDA take the opportunity it now has to break with the mistakes of the past, that it postpone for a decade or so any push to commercialize the LMFBR, cancelling the CRBRP and relegating the overall program to a relatively low-priority effort, and that it accelerate the development of attractive non-fission alternatives such as solar, geothermal, fusion and energy conservation. Much can be learned during the coming decade -- most likely we will learn that the breeder can be bypassed -- and the delay would impose no penalty on the nation.

Breeder Impacts: Unprecedented Risks

The LMFBR program has proceeded in the face of mounting apprehension within the scientific community concerning the human and societal hazards of nuclear fission reactors, apprehension which would only be increased by the LMFBR. As evidence of this apprehension, scientists from many nations at the 23rd Pugwash Conference on Science and World Affairs in September, 1973, concluded:

> "1. Owing to potentially grave and as yet unresolved problems related to waste management, diversion of fissionable material, and major radioactivity releases arising from accidents, natural disasters, sabotage, or acts of war, the wisdom of a commitment to nuclear fission as a principal energy source for mankind must be seriously questioned at the present time.

"2. Accordingly, research and development of alternative energy sources -- particularly solar, geothermal and fusion energy, and cleaner technologies for fossil fuels -- should be greatly accelerated.

"3. Broadly based studies aimed at the assessment of the relation between genuine and sustainable energy needs, as opposed to projected demands, are required."

Addressing the risks of the LMFBR specifically, the Pugwash scientists concluded that the LMFBR would not eliminate any of the hazards we now associate with nuclear power but in critical respects would actually heighten them. The principal advantage of the LMFBR is its ability to produce or "breed" unprecedented quantities of plutonium. Today's nuclear reactors also produce plutonium, but the LMFBR is designed to produce more of this nuclear fuel than it consumes. By the year 2020, the AEC projected total plutonium generation to exceed 30,000 tons, principally from the LMFBR.[9]

Unfortunately, as events are making us painfully aware, plutonium is probably the most dangerous substance known.[10] It is fiendishly toxic: a millionth of a gram has been shown capable of producing cancer in experimental animals. Plutonium-239, the principal isotope of the element, has a half-life of 24,000 years, so that its radioactivity is undiminished within human time scales.

Plutonium is also the substance from which nuclear weapons are made. An amount the size of a softball is enough for the production of a nuclear explosive capable of mass destruction. Scientists widely recognize that the design and manufacture of a crude atomic bomb is not a technically difficult task,[11] a fact dramatized recently when a Massachusetts Institute of Technology undergraduate successfully designed a nuclear weapon for an educational television program.[12] The only real obstacle to the building of homemade atomic bombs is the availability of plutonium itself, and now, first with the proposed use of plutonium in today's reactors and even more with the introduction of the LMFBR, this final obstacle would be removed. In the "plutonium economy" envisioned by the AEC, a plutonium black market and nuclear theft and terrorism become high probability events -- threats real enough to have spurred nuclear proponents to urge the creation of a federal security system that would meddle with our civil liberties on a vast scale.[13]

In addition, the LMFBR itself is considered even less safe than today's light water reactors. The LMFBR core, where the heat is generated, is far more compact than a light water reactor core, and instead of water the LMFBR uses liquid sodium -- an opaque and highly reactive element -- as coolant. Partial loss of coolant -- "voiding" -- in a breeder increases the nuclear reaction in the core rather than reducing it. The LMFBR's operation is extremely sensitive to fuel motion and loss of coolant from the core in accident situations, leading to the possibility of an explosive nuclear runaway. In the event of a meltdown, the breeder's highly enriched fuel can rearrange itself into a more compact configuration with the possibility of small nuclear explosions of sufficient force to breach the reactor containment. There are major uncertainties in defining the explosive potential of the breeder, which are all the more worrisome considering the several tons of plutonium in it.[14]

For these reasons, a decision to commit this nation to the LMFBR may prove to be the most significant technological decision since the Manhattan Project. The breeder reactor decision is literally a decision for all people and all time. Any action which actually increases the likelihood that the breeder and the plutonium economy will become realities should be taken only with the most compelling justification.

Breeder Economics: Missing Benefits

The stated justification for the LMFBR runs along the following lines. As the nuclear power industry expands the U.S. is slowly depleting its low-cost uranium reserves, with the result that the price of uranium is rising and is expected to continue to do so. The principal substitute for uranium is plutonium, a man-made element produced in nuclear reactors. Since the LMFBR generates about twice as much plutonium as today's reactors, its use would tend to expand greatly the supply of nuclear fuel, perhaps 50-fold, and accordingly hold down its price.

Because of the LMFBR's advantage as a plutonium producer, the AEC in the mid-1960's made achieving its early commercialization the agency's highest priority objective. The current program is geared to achieving commercial introduction in about 12 years, i.e. in about 1987.

How sound is the economic case for the early commercialization of the LMFBR? Not very, we believe. The most useful methodology for pulling together the many variables which determine whether the current LMFBR program can be justified economically is cost-benefit analysis. The AEC performed three cost-benefit analyses of the LMFBR program, the latest appearing first in the Draft and then with revisions in the Proposed Final Environmental Statement for the program. Not surprisingly, constrained to justify its own project, the AEC consistently found that program benefits outweigh the costs. Significantly, the Environmental Protection Agency ruled that the AEC's Draft Environmental Impact Statement was inadequate largely because of deficiencies in the AEC's cost-benefit analysis.

When cost-benefit methodology is applied to the LMFBR program, the results are very sensitive to the assumptions made regarding (1) the capital cost difference between the breeder and conventional reactors; (2) the anticipated supply of uranium; (3) future electrical energy demand; (4) the rate at which conventional reactors penetrate the utility market; (5) the discount rate; (6) the R&D cost of the breeder program; and (7) the reactor performance data for the breeder. The first three of these are extremely important.

The AEC succeeded in making the LMFBR appear attractive by making very favorable, but very unrealistic, assumptions in each of the seven areas listed.* In the Appendix to this report, we have evaluated the economic merits of the LMFBR program using the AEC's cost-benefit methodology but looking outside the AEC to independent opinion as to what assumptions should be made in each critical area. Taking this approach, we demonstrate that the expected economic benefits of the breeder are only a small fraction of the R&D costs. For every $10 spent on developing the breeder, the public will get back

*/ In the introduction to its recent proposed final impact statement for the LMFBR program, but not in the cost-benefit analysis itself, the AEC was apparently forced by the press of events, including the recent deferrals and cancellations of planned reactors, to abandon its unrealistic assumptions regarding future energy demand and LMFBR introduction date. Using what the AEC now considers more reasonable assumptions in these two areas, but without changing any of the other AEC assumptions, the net benefits of the LMFBR program drop to zero. In other words, by the AEC's own reckoning the present breeder program can no longer be justified economically. See Appendix, pp. 44-48.

only $1 or less in lower energy costs. In sum, when assumptions based on the work of expert authorities outside the AEC are used, the present LMFBR program simply cannot be justified economically. Only when a series of highly unrealistic assumptions are made does the analysis suggest that the LMFBR program will produce net economic benefits.[15]

These results indicate that the commercial introduction date of the breeder can be delayed substantially, probably two decades or more, without economic penalty. The poor performance of the LMFBR in cost-benefit analysis stems from the fact that during much of the period of the analysis (1987-2020) the LMFBR cannot compete economically with alternative sources largely because of its high capital costs, so that only a limited number of LMFBR's are constructed. For example, until the price of uranium rises sufficiently to offset the high capital costs of the LMFBR, utilities will continue to prefer today's reactors. Using the data set out in the Appendix, we have estimated that not until after the year 2010 can it be expected that the LMFBR would gain a competitive edge over present-day reactors.[16] This date is approximately two decades beyond the LMFBR commercial introduction in the current program schedule. Similar conclusions have been reached by others. David Rose, writing in Science, stated recently:

> "I estimate that the breeder will almost surely be attractive when U_3O_8 reaches $50 a pound in 1974 dollars. That will not happen in the first few decades of the 21st century. In the meantime, nuclear power is in no danger of losing out to other fuels, and there does not need to be a crash breeder program. Economic introduction at A.D. 2000 would be a sign of technological good fortune, not of resolving an energy crisis with a time limit."[17]

In sum, the current rush to introduce the breeder is hardly justified. Postponement would impose no penalty, and it would focus attention and effort on the promising non-fission alternatives to the LMFBR.

Alternatives to the Breeder: New Possibilities

A fission-free option to the LMFBR which can provide reasonably priced and environmentally acceptable energy almost certainly exists and can be made available within a suitable timeframe. The claim that the LMFBR or other breeder reactor is in any sense necessary must be rejected -- the breeder is no more necessary than we make it by refraining from developing other technologies. What is proposed here is an energy program which should be able to provide an adequate supply of fuels and electric power without the commercial utilization of breeder reactors. Moreover, as we shall show, heavier reliance upon the various aspects of this program would facilitate phasing-out all fission reactors, leading to a fission-free energy economy.

In brief outline, there are several major efforts the adoption of which is central to an alternative energy program:[18]

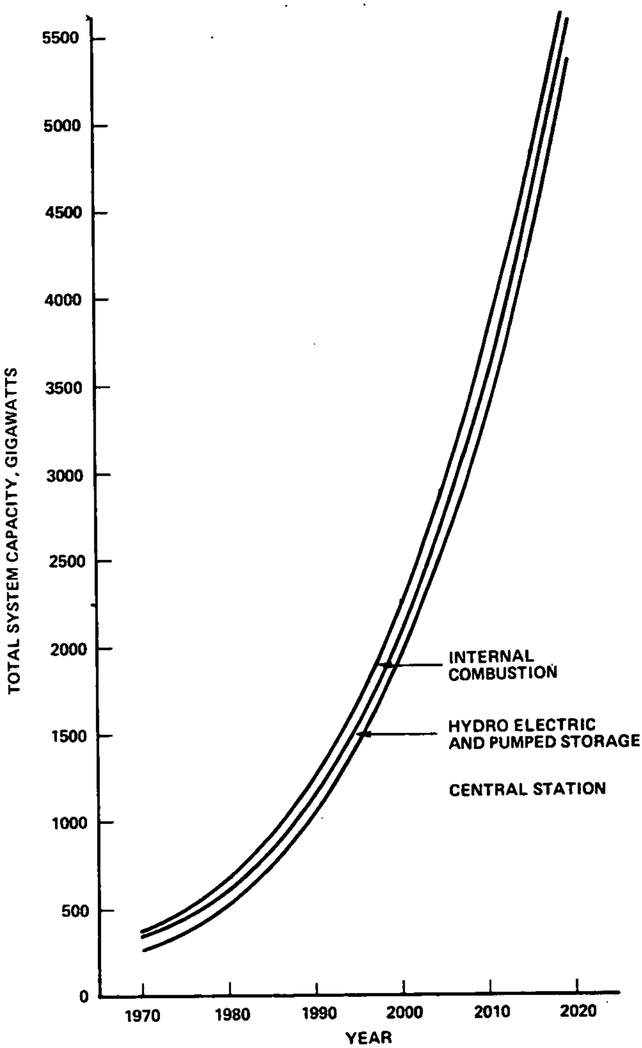
- An intensive effort to develop the various forms of solar energy should be undertaken following the recommendations of the expert panels convened under National Science Foundation auspices, An Assessment of Solar Energy as a National Energy Resource (1972) and Solar and other Energy Sources: Subpanel IX Report (1973).[19] In estimates which it believed were not the highest possible, the first of these studies concluded that its recommended R&D program could result by the year 2020 in solar energy providing 35% of the nation's total building heating and cooling load, 30% of the nation's gaseous fuel, 10% of its liquid fuel, and -- most important for present purposes -- 20% of the electrical energy requirements.[20]

- A major R&D effort devoted to exploitation of geothermal resources for electric generation should be launched. The Cornell Workshop on Energy and the Environment (1972) concluded that "[i]t appears that geothermal energy alone is capable of meeting all American power requirements for several centuries if the hot dry rocks resource proves to be practical."[21] The Cornell Workshop, the National Science Foundation, and others have recommended that a program to establish the feasibility of hot rock geothermal in the next few years be given highest priority. Projections of the electric power available from geothermal resources range from 80 to 400 GWe in the year 2000, depending on assumptions made about the hot rock potential.[22] The AEC recently estimated that geothermal heat could supply 6% of our electricity in the year 2020,[23] but it is clear that the percentage could be much higher if hot rock geothermal develops as expected.

- The current effort to develop fusion power should be expanded. The AEC recently stated that "a successful, vigorously supported fusion program would be expected to lead to construction of a demonstration power reactor that would begin operation in the mid-1990's."[24] The agency anticipated "commercial introduction of fusion power plants on a significant scale beginning in the early 21st century."[25] Thus, it now appears that the demonstration fusion power plant is not far behind the LMFBR demonstration plant and that fusion plants can be available commercially for much of the period during which it was assumed the LMFBR would be critically needed. The AEC's overall estimate is that by the year 2020 about 8% of our electricity could come from fusion.[26]

- Organic wastes provide another source of fission-free energy that should be developed. Here the AEC estimates that organic wastes could account for 5% of the demand for electricity in the year 2000 but only 2% in 2020 due to more efficient practices in the solid wastes area.[27]

- All of the above year 2020 percentage contributions, e.g. 20% for solar, 6% for geothermal, etc., are based upon a year 2020 energy demand that assumes a continuation of extremely rapid growth in electricity demand. Such projections can yield an electricity consumption in the year 2020 that is over fifteen times today's, a result widely regarded as completely unrealistic. For illustration, the electricity growth projection used by the AEC to justify the LMFBR program is set out on the following page. The steepness of the curve staggers the imagination. Several studies of the future demand for electricity have been carried out using more sophisticated forecasting techniques and taking into account the effects of the increasing price of electricity and other market factors. These studies suggest that actual future demand will be less than half of that projected by the AEC.[28] Moreover, as a supplement to market influences, it is apparent that the U.S. is moving towards a national energy conservation policy along the lines recently suggested by the House Committee on Science and Astronautics, the Council on Environmental Quality, the Ford Foundation Energy Policy Project and others.[29] These groups all suggest that U.S. energy growth can be roughly halved without serious adverse repercussions on the American economy or lifestyle. When both market and policy influences are taken into account, we believe it is reasonable, in fact, conservative, to assume



PROJECTED DEMAND FOR ELECTRICAL GENERATING CAPACITY 1970-2020

Source: AEC, Proposed Final Environmental Impact Statement for LMFBR Program (December, 1974), Vol. IV, p. 9.1-3.

that electricity demand in the year 2020 will not exceed 50% of the AEC's astronomical projection.

Table 1 summarizes some of the data presented in the preceding paragraphs. It shows that it is not unreasonable to expect that over 80% of the electricity demand projected by the AEC for the year 2020 can be accounted for principally by a combination of solar, geothermal, and fusion energy together with more accurate forecasting of energy demand. This percentage is larger by a substantial margin than the contribution expected of the LMFBR by the AEC in 2020(50%) and, indeed, is larger than the contribution the AEC expected from nuclear fission generally (70%). Accordingly, an energy program designed to achieve these objectives could wholly eliminate the need for the LMFBR even if it failed in major respects.

Table 1 indicates that other sources, principally fossil fuels, could be called upon to provide the remaining portion of U.S. electricity needs in 2020. It is likely that our abundant supplies of coal will be relied upon for several decades as a significant power plant fuel. Thus, quite apart from the question of whether the LMFBR is introduced, the development of environmentally responsible means of mining and utilizing coal must be an essential and high priority national objective. The contents of an R&D effort aimed at achieving this objective have been discussed by numerous authors.[30] Elements include strict regulation of surface mining, more efficient and safer technologies for mining deep coal, stack gas cleanup, new combustion technologies and coal gasification and liquification.

Table I

Energy Sources for Electricity Production

in the Year 2020 Without the Breeder

	Trillions of Kilowatt Hours	Percent of AEC Projection	Source
AEC Projection	27.6	100	(1)
New Energy Sources			
Solar	5.5	20	(2)
Geothermal	1.7	6	(3)
Fusion	2.2	8	(4)
Organic Wastes	.6	2	(5)
	10.0	36	
Correction for Market Factors and Energy Conservation	13.8	50	
Total Accounted For	23.8	86	
Remainder for Other Sources (principally fossil fuels)	3.8	14	

Sources:

1. Proposed Final EIS for LMFBR Program, Vol. IV, p. 11.1-25
2. NSF/NASA, Solar Energy as a National Resource (1972), p. 3. Proposed Final EIS for LMFBR Program, Vol. IV, p. 11.1-19
3. Proposed Final EIS for LMFBR Program, Vol. IV, p. 11.1-20
4. Proposed Final EIS for LMFBR Program, Vol. IV, p. 11.1-22
5. Proposed Final EIS for LMFBR Program, Vol. IV, p. 11.1-21

The funding needed for this alternative energy strategy would not be unacceptably high. It is significant that the last of the AEC's official projections of future LMFBR expenditures, $8 billion to program completion, exceeds a recent Federal Power Commission estimate of the total R&D costs of developing all non-nuclear technologies, including coal gasification, solar (direct and indirect) and geothermal technologies, advanced steam cycles, MHD, fossil fuel effluent controls, and a variety of energy storage systems.[31] The FPC estimate of $6 billion, however, does not include the cost of developing fusion systems, which is expected to be comparable to that of the LMFBR.[32]

The last refuge of the breeder proponent is the argument that the LMFBR is needed as an "insurance policy." The above considerations indicate that this is simply not the case. Ample insurance exists partly in pursuing a variety of non-conventional energy sources and energy conservation and partly in realizing that the AEC would insure us against a non-existent risk -- the risk that our electrical generating capacity will actually grow as that agency projected. Moreover, relegating the LMFBR program to a low-priority status and foregoing any expensive push towards demonstration and commercial reactors for from one to two decades does not permanently eliminate the LMFBR option. If within about a decade it becomes clear that possible non-fission options are not going to be available, consideration can be given at that time to reinitiating the program. The idea that there is a penalty for such a postponement, is, as we have seen, wholly spurious.

<u>What Should Be Done With the LMFBR Program?</u>

Almost everyone, we believe, would prefer to bypass reliance upon the breeder reactor and move directly into using solar, geothermal and fusion energy and energy conservation. The real LMFBR debate centers around whether it is possible to make this leap. We join many experts in believing that it is. Yet, unfortunately, no one will ever know the answer to this question if the present LMFBR program is permitted to continue. By swelling the bureaucratic and industrial forces committed to the LMFBR and by draining away R&D funds that are essential to the timely development of the alternatives that could replace the reactor, the LMFBR program is its own self-fulfilling prophesy.

As a way out of this quandary, we suggest an option to the present program which meets the objections of both optimists and pessimists and therefore should command general support. First, federal energy officials should delay the LMFBR program a decade. We have seen that the program is premature and that there is no penalty in such delay. During this period, the LMFBR effort should be recast as a low-priority program centered on the FFTF, and current plans for going ahead with the costly Clinch River demonstration plant should be cancelled. By greatly reducing the overall costs of the program, funds will be freed for the accelerated development of solar, geothermal, fossil, fusion and conservation technologies, and the tremendous public and private investments which could foreclose the option of ever stopping the LMFBR will be avoided. The 10-year postponement would also provide a period during which several types of data which bear critically upon the desirability of the

LMFBR program could be gathered and assessed. First, more accurate information on uranium availability and future energy demand could be obtained. Second, during the coming decade knowledge regarding the potential of solar, geothermal, and fusion energy should increase dramatically with appropriate funding. And, third, this grace period could also be used to answer critical health and safety questions raised by the LMFBR with far more certainty than now present.

The problems associated with the present reactor program strongly suggest that we are only perpetuating and compounding a bureaucratic blunder by pursuing the current LMFBR program. The alternative strategy suggested here would provide an opportunity to correct that mistake--before it is too late. Construction is scheduled to commence on the Clinch River demonstration plant towards the end of this year, with the necessary approvals coming much sooner. Once these hurdles are cleared, it will be far more difficult to reorient this increasingly massive program.

FOOTNOTES

1. Office of the White House Press Secretary, Remarks of President Nixon at the AEC Reservation, Hanford Works, Hanford, Washington, September 26, 1971.

2. U.S. Energy Research and Development Agency, Summary of Budget Estimates, Fiscal Year 1976, February, 1975.

3. The Atomic Energy Commission's Proposed Final Environmental Impact Statement for Liquid Metal Fast Breeder Reactor Program, WASH-1535 (December, 1974), Vol. IV, p. 11.2-33 (cited herein as "PFEIS, LMFBR"), estimates that an additional $8.1 billion must be spent to develop the LMFBR. Approximately $2 billion has already been spent.

4. In July , 1973, the AEC estimated total program costs at between $4 and $5 billion. AEC, Determination Pending Preparation of NEPA Impact Statement, 38 Fed. Reg. 19855 (July 24, 1973).

5. U.S. General Accounting Office, "Staff Study, Fast Flux Test Facility Program," January, 1975, p. 7.

6. The cost overruns associated with the proposed Clinch River demonstration plant are discussed in detail in the Appendix to this report, at page 9.

7. This economic analysis is contained in the Appendix to this report.

8. The non-fission alternatives to the LMFBR are discussed at pages 10-16 of this report.

9. PFEIS, LMFBR, Vol. IV, p. 9.1-47.

10. J. Gustave Speth, Arthur R. Tamplin and Thomas B. Cochran, "Plutonium Recycle: The Fateful Step," The Bulletin of the Atomic Scientists (November, 1974), p. 15, addresses plutonium related hazards.

11. Mason Willrich and Theodore B. Taylor, Nuclear Theft: Risks and Safeguards (1974); AEC, "The Threat of Nuclear Theft and Sabotage" (Rosenbaum Report), Congressional Record, April 30, 1974, p. S6621.

12. New York Times, February 27, 1975 ("Bill Asks Curb on Plutonium Use To Prevent Building of Homemade Bomb").

13. AEC proposals for a federal security system are discussed in "Plutonium Recycle: The Fateful Step," op. cit., and the sources cited there.

14. Thomas B. Cochran, The Liquid Metal Fast Breeder Reactor: An Environmental and Economic Critique (1974), Chapter 7.

15. Appendix, pp. 39-44.

16. Appendix, pp. 48-49.

17. David J. Rose, "Nuclear Eclectic Power," Science (April, 1974), p. 357.

18. This program is elaborated and more extensively referenced in Natural Resources Defense Council, Comments on the Draft Environmental Impact Statement for the Liquid Metal Fast Breeder Reactor Program: Alternative Technology Options, printed in PFEIS, LMFBR Vol. VI.

19. NSF/NASA Solar Energy Panel, An Assessment of Solar Energy as a National Energy Resource, National Science Foundation, Washington, D.C., December 1972; Alfred J. Eggers, et al., Subpanel IX Report: Solar and Other Energy Resources, National Science Foundation, October 27, 1973.

20. An Assessment of Solar Energy, op. cit.

21. Cornell Workshop on Energy and the Environment, Summary Report, Committee on Interior and Insular Affairs, U.S. Senate, May, 1972, pp. 114-15.

22. See, e.g., Walter J. Hickel, et al., Geothermal Energy, NSF/RANN-73-003, University of Alaska, 1973, p. 7; Dixy Lee Ray, Chairman, AEC, The Nation's Energy Future: A Report Submitted to President Richard M. Nixon (1973).

23. PFEIS, LMFBR, Vol. IV, p. 11.1-20.

24. PFEIS, LMFBR, Vol. III, P. 6A.1-191.

25. PFEIS, LMFBR, Vol. III, p. 6A.1-179

26. PFEIS, LMFBR, Vol. IV, p. 11.1-22.

27. PFEIS, LMFBR, Vol. IV, p. 11.1-21.

28. The electricity demand issue is discussed in detail in the Appendix, pp. 21-28, and in NRDC Comments on Draft LMFBR EIS, Alternative Technology Options, op. cit.

29. Conservation and Efficient Use of Energy, Report of the Committee on Science and Astronautics, U.S. House of Representatives, December 18, 1974; Council on Environmental Quality, "The Half and Half Plan For Energy Conservation," printed in Fifth Annual Report of the Council on Environmental Quality (1974), p. 475; Energy Policy Project of the Ford Foundation, A Time to Choose (1974), Chapters 3-6.

30. See, *e.g.*, PFEIS, LMFBR, Vol. III, pp. 6A.2-1 through 6A.2-51, and the references cited there; *The Nation's Energy Future*, *op. cit.*; Hammond, *et al.*, *Energy and the Future* (1973), Part I.

31. Federal Power Commission, Report of the Task Force on Energy Conversion Research to the Technical Advisory Committee on Research and Development, November, 1973, DRAFT.

32. PFEIS, LMFBR, Vol. III, p. 6A.1-189.

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APPENDIX

Bypassing the Breeder

A Report on Misplaced Federal Energy Priorities

By

Thomas B. Cochran
J. Gustave Speth
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March, 1975

APPENDIX

Economic Analysis of the LMFBR Program

I. Introduction

The Atomic Energy Commission has now written and released three cost-benefit analyses of the U.S. Liquid Metal Fast Breeder Reactor (LMFBR) Program.1/ Operating under the

1/ The first, written in 1968, was released in 1969;*/ an updated (1970) analysis was released in May, 1972;**/ and the latest (1973) analysis appeared first in the AEC's Draft***/ and then with revisions in the Proposed Final Environmental Impact Statement on the LMFBR Program.****/ The basic arguments have not changed in this progression of cost-benefit analyses and the principal differences are in the updating of numbers.

*/ U.S. Atomic Energy Commission, Division of Reactor Development and Technology, Cost-Benefit Analysis of the U.S. Breeder Reactor Program, WASH-1126 (April, 1969).

**/ U.S. Atomic Energy Commission, Division of Reactor Development and Technology, Updated (1970) Cost-Benefit Analysis of the U.S. Breeder Reactor Program, WASH-1184 (January, 1972). This analysis was reviewed in detail by Thomas B. Cochran in The Liquid Metal Fast Breeder Reactor: An Environmental and Economic Critique. Resources for the Future, Inc., Washington, D. C. (March, 1974).

***/ U.S. Atomic Energy Commission, LMFBR Environmental Impact Statement, DRAFT, WASH-1535 (March, 1974). Vol.I, pp.1.11-1 to 1.11-3; Vol.III, pp.11.1-1 to 11.2-21; Vol.III, Appendix III-B, pp.B-1 to 4-41 and Vol.III, Appendix III-B, Annex A, pp.A-1 to A-7.

****/ U.S. Atomic Energy Commission, Proposed Final Environmental Impact Statement [PFEIS], LMFBR, WASH-1535 (December, 1974), Vol.IV, pp.11.2-1 to 11.3-3, Appendix IV- B, C, and D.

constraint of having to justify its own program, it is not surprising that each of the AEC's cost-benefit analyses concludes that the sum of the benefits of the breeder program will exceed the program cost.

The AEC's results, however, depend critically upon the accuracy of its assumptions regarding (a) the choice of the discount rate; (b) the cost of the breeder research and development program; (c) the capital cost difference between LMFBR and conventional nuclear reactors; (d) the future demand for electricity; (e) the growth in rate conventional nuclear reactors penetrate the utility market; and (f) the domestic supply of uranium. It is our purpose in this Appendix to evaluate the economic merits of the LMFBR program using what we and many independent experts consider more realistic input assumptions than those used by the AEC.

To carry out this analysis, we rely on the AEC's cost-benefit model. There are several advantages to this approach. (1) We are not subject to the criticism of using a less detailed model. Differences in results are not to be traced to certain omissions in our model. (2) We can narrowly focus the breeder economic debate on a few of the more sensitive input assumptions. Those less familiar with the subject can quickly grasp the key issues that account for the differences of opinion about the breeder's economic merit and more easily form their own opinions. (3) The analysis on our part is greatly simplified since we do not have to construct our own model or research the many less relevant input assumptions. The drawback of this approach is that we are constrained in our choice of input assumption since we are forced to rely on values considered by the AEC.

In each of the AEC's cost-benefit analyses, the gross benefit of the LMFBR program is measured by the difference between the cost of meeting a prescribed demand for electricity between now and 2020 with and without the LMFBR -- the gross benefit being positive when the LMFBR is able to produce electricity more cheaply than other sources. The costs of providing electricity, with and without the breeder, are calculated by means of a computer program which schedules the introduction of power stations to meet the demand in the least costly way. The yearly differences in cost, with and without the breeder, are discounted back to the present and added together to form the AEC measure of gross benefit of the breeder program. In the cost-benefit balance this measure of gross benefit is compared with the cost of the LMFBR R&D program. The difference between the gross benefit and the R&D costs is the net benefit of the breeder program.

Each of the AEC's cost-benefit analyses has included a sensitivity analysis where several of the key input assumptions are varied to determine their effect on the computed benefits. Fortunately, at the behest of EPA and others, the AEC has provided, in its most recent analysis, cases using more realistic combinations of input assumptions. While these more realistic assumptions still are not what we would consider best estimates, some combinations are close enough to provide an acceptably realistic evaluation of the potential benefits of the LMFBR program. Our approach is to consider each critical input assumption tested by the AEC. We then select from among these various assumptions those which most nearly conform to the facts and consensus of independent expert opinion. The assumptions thus selected constitute NRDC base case assumptions for purposes of this report.[2/] Finally, we

2/ A detailed discussion of our assumptions and arguments for rejecting the AEC's "best estimates" of these parameters was provided in "NRDC's Comments on the DRAFT Environmental Impact Statement of the LMFBR Program." Reproduced in PFEIS, LMFBR, Vol.VI,pp.38-158 to 38-236. Similar criticisms by EPA are found in PFEIS, LMFBR, Vol.VII, pp.53-1 to 53-98.

include an analysis of the sensitivity of NRDC's base case results to changes in the key assumptions. Our analysis here is extremely limited because we are restricted to sets of assumptions actually considered by the AEC.

II. Basic Assumptions

A) Discount Rate: We use 10 percent/year.

The basis for using a discount rate of at least ten percent per year is presented in NRDC Comments on WASH-1535.[3/] The issue of the appropriate discount rate has largely been laid to rest, as the AEC now uses the 10 percent/year value, "based on the preferences of OMB and other organizations and individuals."[4/] This rate is also consistent with the recommendation of EPA.[5/]

3/ "NRDC's Comments on the DRAFT Environmental Impact Statement of the LMFBR Program." Reproduced in PFEIS, LMFBR, Vol.VI, December, 1974. U.S. Atomic Energy Commission, pp.38-162 to 38-164. See also, Cochran, Thomas B., Op. Cit., pp.23-29.

4/ U.S. Atomic Energy Commission, Proposed Final Environmental Impact Statement [PFEIS], LMFBR, WASH-1535 (December, 1974), Vol.IV, p.11.2-47.

5/ EPA Comments on DRAFT EIS, LMFBR Program. Reproduced in PFEIS, LMFBR Program, Vol.VII, pp.53-35 to 53-38.

B) Research and Development Costs: We use $8.4 billion assuming LMFBR commercial introduction in 1987. Discounted at 10% per year this is equivalent to $4.7 billion in mid-1974 dollars.

These are the values assumed by the AEC, and for purposes of this analysis they will be considered NRDC base case assumptions as well. In reality, however, we believe the R&D costs of the LMFBR Program will be substantially higher for reasons outlined below.

Initial cost estimates of the LMFBR program made in the mid-1960's were about $1.8 billion to $2.2 billion. Now that we have spent roughly that amount, the AEC (now ERDA) tells us we must spend another $8.1 billion 6/ to achieve LMFBR program objectives. Only a small fraction of this enormous overrun can be attributed to inflation. As seen from Table 1, the estimated cost to complete the LMFBR program has increased enormously in recent years. In fact, the curve of estimated additional LMFBR program expenditures as function of time is diverging from the curve

6/ U.S. Atomic Energy Commission, Proposed Final Environmental Impact Statement [PFEIS], LMFBR, WASH-1535 (December, 1974), Vol.IV, p.11.2-33.

Table 1

Estimates of the Undiscounted Breeder Program Expenditures from AEC Cost-Benefit Analyses

	1968[a] Estimate	1970[b] Estimate	late-1973[c] Estimate	late-1974[d] Estimate
Breeders				
LMFBR	2.2	2.5	4.0	6.5
Other Breeders	0.8	0.1	0.2	1.4
Support Technology	1.4	1.2	2.6	1.6
Total Breeders	4.4	3.8	6.8	9.5
Non-Breeders	0.7	0.5	0.5	0.7
General Support	2.6	2.5	(not given)	(not given)

a) U.S.AEC, WASH-1126, Op. Cit., 1970 dollars, assumes 1986 LMFBR commercial introduction.

b) U.S.AEC, WASH-1184, Op. Cit., mid-1971 dollars, assumes 1986 LMFBR commercial introduction.

c) U.S.AEC, WASH-1535, DRAFT EIS, LMFBR Program, Op. Cit., mid-1974 dollars, assumes 1987 LMFBR commercial introduction.

d) U.S.AEC, WASH-1535, PFEIS, LMFBR Program, Op. Cit., mid-1974 dollars, assumes 1987 LMFBR commercial introduction.

of cumulative expenditures to date, even when using constant dollars. As long as this trend continued, ERDA projections of additional program expenditures will understate the true cost and the ultimate expenditure ceiling will remain unknown.

Significantly, the Fast Flux Test Facility (FFTF), an essential component of the LMFBR Program, was authorized in 1966 at $87.5 million. In June 1974, the GAO estimated the cost of the FFTF Program to be more than $933 million,[7/] over ten times higher than the original estimates. Based on AEC's assessment, it appears to GAO that it will again be necessary for AEC to increase its program cost estimate to reflect rapidly increasing costs.[8/] As of March 1974, the design was about 75 percent complete and construction 30 percent.[9/] Unfortunately, there are still unresolved FFTF safety issues related to its capability to withstand core disruptive accidents which could be extremely costly.

7/ GAO, "Staff study, Fast Flux Test Facility Program" U.S. Atomic Energy Commission, January 1975, p.7.

8/ Ibid., p.16.

9/ Ibid., p.1.

The second most significant component of the LMFBR Program is the Clinch River Breeder Reactor (CRBR), the first LMFBR demonstration plant if one overlooks Fermi-I.[10/] The first official estimate of its cost was about $400 million. In a 1972 Memorandum of Understanding its cost was estimated at $700 million, two-thirds coming from the AEC and with the AEC (now ERDA) assuming an open-ended risk (i.e., all the cost overruns). This estimate was $150 ao $200 million higher than an AEC estimate only six months previous. In March 1974, it was reported that CRBR project officials are "focusing on some major steps that they hope will hold the total cost of the plant under $1.0 billion.[11/] In July, it was reported that the CRBR project would cost $1.6 - $2.0 billion,[12/] and in September it was pegged at $1.736 billion.[13/] Unfortunately, the demonstration plant of the federal government's priority energy program has a cost doubling time of one year and a fuel doubling time of 30 to 60 years, instead of the reverse (See Figure 1).

10/ Fermi-I, the first commercial LMFBR plant, experienced a partial core meltdown and has subsequently been shut down.

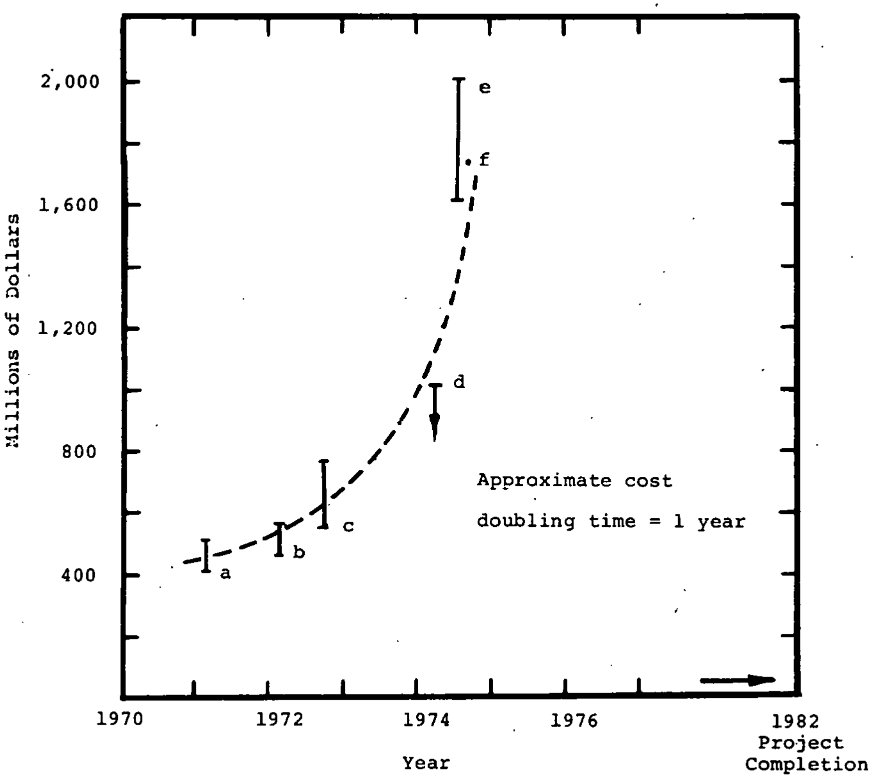
11/ Nucleonics Week 15, March 21, 1974, p.1.

12/ Weekly Energy Report 30, July 29, 1974, p.1.

13/ Weekly Energy Report, 38, September 23, 1974, p.5. Given the cost trend the last three significant digits are a joke.

Figure 1

Breeder Reactor (Cost) Doubling Time



AEC estimates of the Range in the Cost of the Clinch River Breeder Reactor.

Source: (a) JCAE Hearings, AEC Authorizing Legislation - FY 1972, p.702.
(b) JCAE Hearings, AEC Authorizing Legislation - FY 1973, pp.1156-1159.
(c) JCAE Hearings, LMFBR Demonstration Plant, Hearings, p.44.
(d) Nucleonics Week, 15, March 21, 1974, p.1.
(e) Weekly Energy Report, 30, July 29, 1974, p.1.
(f) Weekly Energy Report, 38, September 23, 1974, p.6.

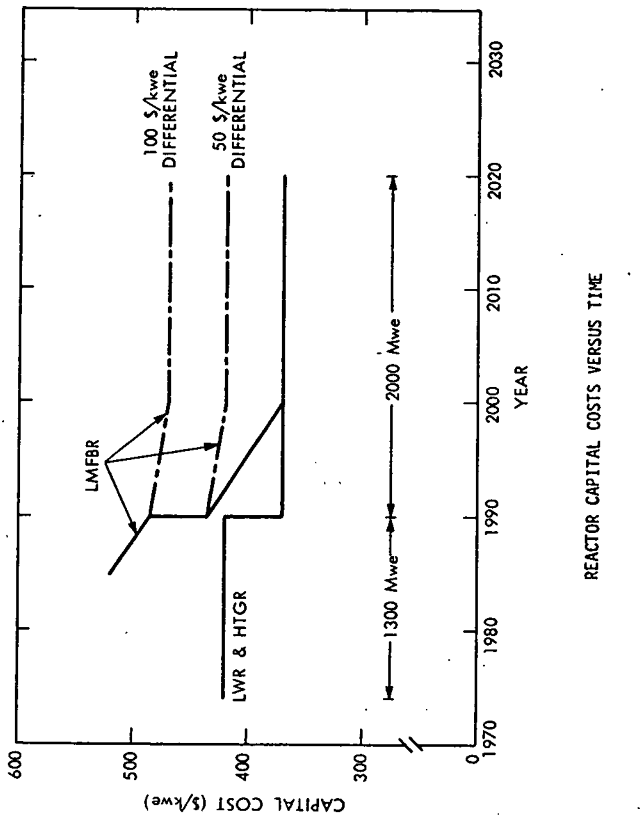
C) <u>Capital Cost Differential: LMFBR capital costs remain $100/Kw higher than conventional reactors</u>.

Curves of reactor capital costs versus time are presented in Figure 2. The upper dotted line in the figure labeled $100/Kw DIFFERENTIAL," represents most nearly our base case assumption for LMFBR capital costs. In reality, we believe the cost differential will be even higher. The solid LMFBR line represents the AEC's base case assumption. The AEC assumes that the LMFBR will cost no more than conventional reactors after 2000 -- a zero cost differential.

All costs are in mid-1974 dollars. Other ground rules for the capital cost estimates are given in the PFEIS of the LMFBR Program.[14/] It is important to note that (a) since all costs in the cost-benefit study are in constant dollars, these costs do not include allowances for escalaction during construction, and (b) no first-of-a-kind or prototype costs associated with demonstration reactors or what the AEC refers to as "near-commercial" plants are included.

14/ PFEIS, LMFBR Program, Vol.IV, pp.11.2-78 to 11.2-81.

Figure 2



Source: PFEIS, LMFBR Program. U.S. Atomic Energy Commission, December, 1974. Vol.IV, p.11.5-7.

The central issue here is whether it is appropriate to apply a learning curve to the LMFBR capital costs in addition to the learning associated with the reduction/elimination of first-of-a-kind or prototype costs. We do not apply a learning curve to the LMFBR capital costs. If anything such an effect should be negative (i.e., increasing costs). The AEC, on the other hand, has assumed a sharp positive learning curve with respect to the LMFBR that reduces the present value of LMFBR costs by 21.5% in the short 13 year period between 1987 and 2000. This corresponds to 16 percent per decade. Furthermore, this period of learning is assumed to start immediately upon commercial introduction of the LMFBR.

There are four significant points we wish to make with respect to this difference of opinion. The first concerns the appropriate industry against which the LMFBR learning curve should be compared. The AEC concludes that when examined on a classical basis 15/ their assumed LMFBR learning rate "is extremely conservative in comparison with typical values of 80 to 90% learning curves applicable to many industries." 16/ But the appropriate industry for

15/ It has been established by a number of empirical studies that as a general rule, the logarithm of the cost of a product is a decreasing linear function of the logarithm of the number of units that have been produced.

16/ PFEIS, LMFBR Program. Vol.IV. p.11.2-84. December, 1974. We calculate a lower learning rate than does the AEC, but that is not the point here.

comparison is the nuclear industry, particularly the manufacture of commercial nuclear power plants. The AEC has been predicting a learning curve in this industry for the past decade. To the contrary, the cost of commercial nuclear plants has been increasing at an alarming rate, even in constant dollars. The only possible evidence that a product is on its learning curve is to observe cost decreases as a function of incremental production.

Actually a stronger case can be made for projecting further increases in capital costs. Bupp and Derian estimate that the capital cost of conventional LWR is increasing at \$30/Kw to \$50/Kw per year in constant (1973) dollars,[17/] a negative learning effect. This represents an increase in LWR costs on the order of 10 percent per year, again in constant dollars. *A priori* one would think the capital cost differential might be increasing at the same rate -- roughly 10 percent per year. In 1970, the AEC estimated the LMFBR capital cost differential (at commercial introduction in 1986) at \$18/Kw in mid-1971 dollars.[18/] In 1973 this increased to about \$37/Kw in mid-1972 dollars.[19/] In the DRAFT EIS on the

17/ Bupp, E.C., Derian, J.C., Donsimoni, Marie-Paule and Trietel, Robert, "The Economics of Nuclear Power," *Technology Review*, *77*, February 1975, pp.15-25.

18/ U.S. AEC, WASH-1184, *Op.Cit.*, p.37.

19/ Cochran, Thomas B., *Op. Cit.*, p.39.

LMFBR program the capital cost differential was estimated at $85/Kw in mid-1974 dollars, and $100/Kw was actually assumed in the cost-benefit analysis. Thus, we see the LMFBR capital cost differential has been increasing at a rate even faster than 10 percent per year in constant dollars. There is little reason to believe this trend will not continue at this rapid pace.

What makes the AEC's LMFBR learning curve even more unbelievable is that in the same short period, 1987-2000, when LMFBR capital costs are rapidly falling due to learning there is a shift to an advanced LMFBR design in 1991 and again in 1995. Furthermore, in 1990 plant unit sizes increase from 1300 MW to 2000 MW with an additional 12 percent decrease in price.

Due to the difficulty of incorporating into the AEC's model a learning effect as a function of the number of units sold the AEC has arbitrarily assumed both the learning rate and the rate of commercial introduction of the LMFBR. With more logic one could assume no learning and no LMFBR's purchased, arguing that no learning is anticipated, therefore, LMFBR will not be competitive, hence no one will purchase them. The AEC must argue that in their collective wisdom, the utilities will anticipate a learning effect, and then purchase some 220 LMFBRs to generate it. The AEC has also argued (we believe correctly) that utilities are not farsighted enough to purchase long-term uranium feed and enrichment contracts.

The second point is that the AEC's application of a learning curve to LMFBR costs stands in stark contrast to the assumptions of independent investigators. Bupp and Derian, for example, observe:

> "[Because of learning effects] Breeders will not be competitive with LWR's when only 10-20 of the former have been installed as opposed to several hundred of the latter. Consequently, an added cost will be incurred by breeders until their manufacturing costs have decreased enough to compensate for the initial LWR advantage due to fabrication experience. These learning-curve costs must be taken into account even if it is assumed that breeder capital costs will turn out to be below the allowable threshold for previous U_3O_8 prices and other variables. In such circumstances, learning curve costs have to be subtracted from the breeder advantage in order to determine the real benefits of their introduction. . . . Any claim of definitive economic advantage from breeder introduction must therefore take account of costs due to learning effects which could quite easily turn out to be a substantial multiple of R&D costs." 20/

Manne and Yu take a similar approach. 21/

20/ Bupp, Irvin C. and Jean-Claude Derian, "The Breeder Reactor in the U.S.: A New Economic Analysis," Technology Review, July/August 1974, p.34.

21/ Manne, Alan S., and Oliver S. Yu, "Breeder Benefits and Uranium Ore Availability," Electric Power Research Institute, EPRI SR-3, Special Report, October, 1974, p.7. Manne and Yu have estimated that this learning effect plus additional federal and private R&D financing beyond FY-1979 (continued on following page)

The third point concerns the inconsistency of the AEC's approach. The AEC does not apply a similar learning curve to the HTGR, even though no commercial size HTGR's are expected in operation before about 1980 to 1983. The AEC argues that since the HTGR is subject to the same environmental and safety regulations as the conventional light water reactor (LWR),

> ". . . a reasonable assumption would be to hold the HTGR and LWR capital costs equal throughout the time span considered. This assumption still gives the HTGR a competitive advantage in power costs, since it is projected to have lower fuel costs than LWRs. Because of this, it might be concluded that there exists no great market-place incentive for HTGR capital costs to ever become substantially lower than LWR capital costs." 22/

The AEC's position is inconsistant in that it does not apply this same argument to the LMFBR even though a) the LMFBR is subject to the same environmental and safety regulations and b) the LMFBR is projected to have a competitive advantage in power costs before its capital cost differential is reduced to zero.

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could be $4 billion which they add to the LMFBR R&D cost (FY75-79). Adding this learning cost to the R&D cost has the effect of subtracting from the R&D advantage. It appears from their estimate of R&D expenditures alone that Manne and Yu have understated the undiscounted cost of the breeder program.

22/ PFEIS, LMFBR Program, Vol.IV, p.11.2-84.

The final point concerns whether one can justify an LMFBR learning curve on the basis of postulated cost reductions of selected components. The AEC argues that while the trend in absolute costs of LWR plants may increase, this will not alter the cost position of the LWR relative to other plants. The LMFBR cost differential will decrease from $100/Kw initially due primarily to improvements in the design and construction of the steam supply system.[23/] But the direct costs of the reactor plant equipment represent less than 30 percent of the total plant costs.[24/] To obtain the same LMFBR cost reduction, the AEC would have to assume an even greater learning rate for the nuclear island than for the entire plant. Again, looking to the LWR industry for experience we find, according to the AEC:

> ". . . examination of LWR cost trends indicate that the price of the nuclear steam supply system has remained relatively constant over the past several years, exclusive of escalation."25/

In other words, no learning.

The AEC cites six favorable features of LMFBRs which in its estimation will lead to lower capital costs in a mature industry, for example, the LMFBR's low pressure system making possible in plant and system-design simplifications. For

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23/ See, PFEIS, LMFBR, U.S. Atomic Energy Commission. December, 1974. Vol.IV, p.11.2-88.

24/ Ibid., p.11.2-80.

25/ Ibid., p.11.2-83.

every example here, however, there is a counter example which could lead to higher costs. The LMFBR, unlike the LWR, requires an extensive sodium component and piping system heating system required for preheat, wetting and maintaining sodium in a molten state during shutdown. Remote automatic refueling is required under controlled environmental conditions. Reactor manual and automatic control systems in an LMFBR are more complex due to less inherent control features in the reactor nucleonics. The intermediate coolant loop introduces further complexities. We know from experience with light water reactors that these complex systems of large scale development projects such as LMFBRs can easily encounter subtle and unforeseen interactions that result in costly solutions in terms of commercial designs. Primary sodium pumps for the FFTF, for example, were estimated to cost $1.8 million in 1970 and $10.5 million in 1974.[26/] During the same period the cost of the intermediate heat exchanger for the FFTF doubled.[27/] The more we learn about these complex systems, the more we learn they will cost.

The AEC proposes as one cost savings concept, the elimination of the intermediate heat exchanger. However, "the intermediate loop serves as an important safety feature.

26/ GAO, "Staff study, Fast Flux Test Facility Program," U.S. Atomic Energy Commission, January 1975,p.9.

27/ *Ibid*., p.9.

Sodium and water react violently upon contact. The intermediate loop isolates the steam-generator from the primary sodium-coolant loop preventing the possibility of this reaction from taking place in the primary loop, thereby reducing the probability of loss of primary loop integrity. A steam lead into the primary sodium loop could result in severe pressure transients or loss of coolant flow in or loss of coolant from the reactor core. If the intermediate loop were eliminated, the steam generator would still have to have double-walled tubing to reduce the probability of steam leaks into the sodium. At the April 1974 breeder reactor safety conference, Dr. J. F. Petit of CEA-France, reported that his country had studied the possibility of eliminating the intermediate loop and discarded the idea for reasons of economics, aside from the safety question." 28/

In summary, it is our view that a constant $100/Kw represents a conservative estimate of the LMFBR capital cost differential. Based on historical experience, including trends in LWR costs and the LMFBR capital cost differential, the capital cost differential will go even higher. There is no sign that it will even level off.

28/ Dr. J.F. Petit of CEA-France, Session on Fast Reactor Safety Needs, American Nuclear Society -- Fast Reactor Safety Meeting, Beverly Hills, California, April 2, 1974.

D) <u>Electric Energy Demand: We use Curve B in Figure 3, representing a 50% reduction from the AEC's base case (Curve A) in the year 2020</u>.

Before justifying our choice of the energy demand forecast, it is useful to explain how the energy demand projections (Curves A and B in Figure 3) were derived. We begin with the AEC's base case (Curve A).

The AEC's base case is said to be projected with the assistance of an econometric model.[29/] The model is not described in detail and there is insufficient discussion of the model assumptions in the PFEIS or referenced documents to make a detailed critique of the methodology. The AEC's base case electric energy demand projection is thought to be developed along the following lines, or at least is said to be consistent with the following:

1) Real GNP growth is projected on the basis of population and per capita income considerations. Real GNP is assumed to grow at 4%/year between 1970 and 1980; 3.5%/year between 1980 and 2000; and 3.2%/year between 2000 and 2020.[30/]

29/ PFEIS, LMFBR Program, Vol.IV, p.11.2-53.

30/ *Ibid.*, p.11.2-54.

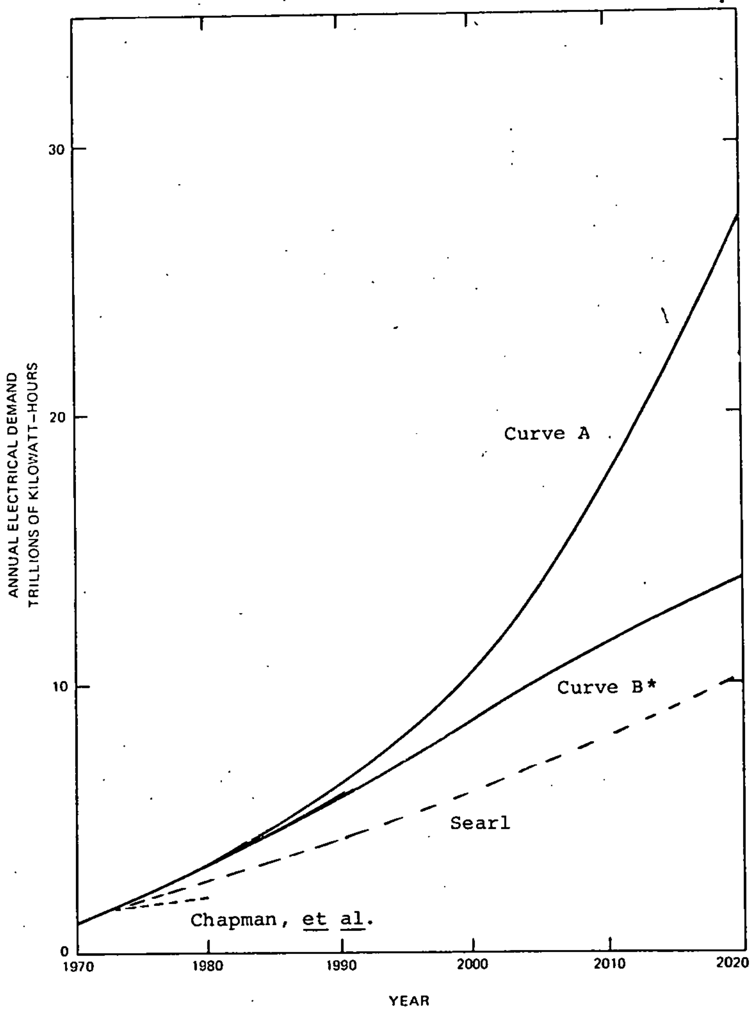

Figure 3

ELECTRIC ENERGY PROJECTIONS USED IN STUDY

* See footnote 33a on p.24.

Source: PFEIS, LMFBR Program, Vol.IV, p.11.2-107

2) Total energy growth is projected assuming energy consumption growth follows real GNP growth for the next 50 years. Total energy is projected to grow from 67 quadrillion Btu in 1970 to 99 quadrillion Btu in 1980; 117 in 1985; 195 in 2000; and 359 in 2020.[31/] This total energy growth rate is comparable to (actually) silghtly higher than the Ford Foundation Energy Policy Project's (Ford-EPP) "Historical Growth" scenario -- 3.5%/year to 2000.[32/]

3) The electric energy demand fraction of the total energy demand is projected assuming the "economy will continue to require a rising share of its energy as electricity because it is a clean and convenient form . . . While the model does not explicitly include electricity prices, implicitly it assumes that at worst the total cost of electricity will not increase faster than the general price level."[33/] The electric energy fraction is assumed to grow from 25 percent in 1970 to 50 percent in 2000,

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31/ PFEIS, LMFBR Program, p.11.2-53.

32/ Ford Foundation's Energy Policy Project, Exploring Energy Choices, A preliminary report, Washington, D.C. (1974), p.41.

33/ DRAFT, EIS, LMFBR Program, Vol.III, Appendix III-B, p.4-33.

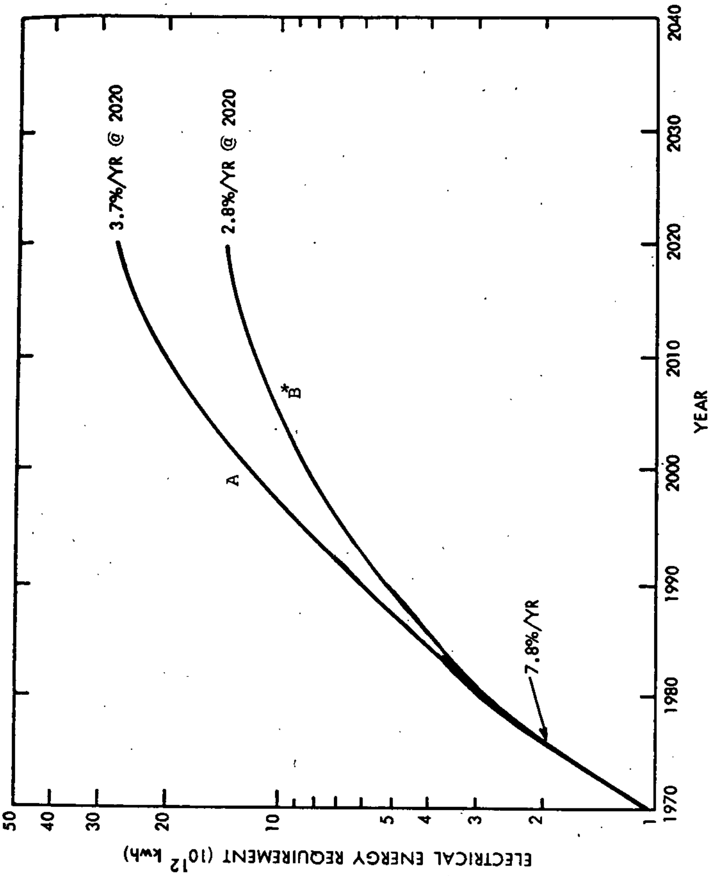
to 65 percent in 2020. This gets us to the AEC's base case electric energy demand (Curve A in Figure 3) which is said to be consistent with a continuously declining growth rate from 7.8%/year initially to 4.2%/year in 2020 (See, Figure 4).

Curve B in Figure 3 (choosen as NRDC's base case) was derived by the AEC by assuming an electric energy demand in 2020 that is 50 percent less than the base case (Curve A). The demand in intermediate years was calculated assuming a continually declining growth rate in the electric energy demand from 7.8%/year initially. The electric energy growth rate in 2020 was calculated to be 2.8%/year. This procedure, or at least the nomenclature, may give the illusion that Curve B, our base case energy demand, is 50 percent less than Curve A, the AEC's base case. This is true only for the year 2020. At intermediate years the difference is less. In the year 2000, for example, the electric energy consumption rate will be 10.6 trillion Kwh according to Curve A, while according to Curve B it will be 7.1 trillion Kwh,[33a/] or only

We are now in a position to justify our choice of Curve B in Figure 3 as NRDC's base case. Our selection is

33a/ PFEIS, LMFBR Program, Vol.IV, p.11.2-58. This value of 7.1 trillion Kwh from the text is not consistent with the figures from the PFEIS reproduced as Figures 3 and 4 in this report. Curve B in the figures shows 8.1 trillion Kwh in 2000.

Figure 4



PROJECTED ELECTRICAL ENERGY REQUIREMENTS

* See footnote 33a on p.24.

Source: PFEIS, LMFBR Program. U.S. Atomic Energy Commission (December, 1974), WASH-1535, Vol.IV, p.11.2-9.

based principally on the forecasts of Chapman, Tyrrell and Mount,[34/] Chapman, _et al_.,[35/] and Searl,[36/] which we have also plotted in Figure 3.

Chapman, Tyrrell and Mount[37/] have noted that the most important economic factors influencing energy demand (in decreasing order of importance) are: 1) the price of electricity; 2) the growth of the population; 3) the growth of income; and 4) the prices of substitute fuels and appliances. Using these parameters and various assumptions about population growth and the increase in cost of electricity, they concluded that the probable electric consumption rate in 2000 will be in the range 1.9 to 4.6 trillion Kwh, and in some cases the rate of growth has turned negative by that time. This range of estimates of the energy demand in 2000 is to be compared

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34/ Chapman, Duane, Timothy Tyrrell, and Timothy Mount, "Energy Demand Growth, the Energy Crisis, and R&D," _Science_, 178 (November 17, 1972).

35/ Chapman, Duane, G. G. Akland, John F. Finklea, Ralph I. Larsen, Timothy Mount, William C. Nelson, Dan C. Quigley, William C. Wilson, "Power Generation, Conservation, Health and Fuel Supply," Revised Draft.

36/ Cochran, Thomas B., _The Liquid Metal Fast Breeder Reactor_, Resources for the Future, Inc., Washington, D.C., (March, 1974), p.110. _See also_, Electric Power Research Institute, "Uranium Resources to Meet Long Term Uranium Requirements," E:RI SR-5, Special Report (November, 1974), p.12.

37/ _Ibid_.

with 7.1 trillion Kwh, NRDC's base case estimate (Curve B) for the same year, and 10.6 trillion Kwh, the AEC's base case estimate (Curve A).

Chapman, Tyrrell and Mount [38/] examined the forecast of the FPC's 1970 National Power Survey on which the AEC has relied, as well as several other similar forecasts, and concluded that these are generally incorrect since their methodologies did not provide quantitative links between energy demand and price and income.

Chapman, et al., [39/] in a report for the 1973 National Power Survey, have updated the electric energy demand forecast using the same model reported by Chapman, Tyrrell and Mount.[40/] Their projected demand for 1980 is 2.2 trillion Kwh, or roughly one-third less than the projected demand using the base case of either NRDC or the AEC. The total electric energy generation in 1973 was 1.85 trillion Kwh. Hence, Chapman, et al.'s forecast of 2.2 trillion Kwh in 1980 represents an average growth rate of about 2.5% compared to the AEC assumption of an average growth rate of about 7.5% over the same period.

The projections of Chapman, Tyrrell and Mount[41/]

38/ Duane Chapman, Timothy Tyrrell, and Timothy Mount, "Energy Demand Growth, the Energy Crisis, and R&D," Science, 178 (November 17, 1972).

39/ Chapman, et al., "Power Generation, Conservation, Health and Fuel Supply," Revised Draft.

40/ Ibid.

41/ Ibid.

and Chapman, *et al.*,[42/] are subject to the criticism that they do not adequately account for some of the recent energy conservation efforts or recent evidence of increased electric energy substitution for alternative fuels, particularly in the industrial sector with respect to the substitution of interruptable natural gas and foreign oil supplies. These two effects are offsetting, at least in part. The AEC's base case projection already has built in considerable substitution of electric energy for alternate fuels. Recall the AEC makes the somewhat arbitrary assumption that electrical energy consumption will grow from 25% of total energy in 1970 to 50% by the year 2000. Therefore, the combined effects of the price of electricity, additional conservation measures and substitution for interruptable fuels will most likely lead to growth rates considerably below those projected by the AEC, although perhaps not as low as Chapman, *et al.*'s projection. The combined effects of price elasticity and conservation efforts in the last 18 months have reduced the electrical energy demand growth rate even below the rate predicted by Chapman, *et al.*[43/] However,

42/ Chapman, *et al.*, "Power Generation, Conservation, Health and Fuel Supply," Revised Draft.

43/ *Ibid.*

it is still too early to tell whether this very low growth rate will persist.

We include Searl's forecast because it is a projection of electrical energy demand versus real GNP directly and does not include the arbitrary assumption that energy consumption will grow to 50% of total energy by 2000 and 65% by 2020. Furthermore, the historical correlation between electric energy demand and real GNP is better than the historical correlation between total energy and real GNP.

Using Searl's expression for electrical energy demand versus GNP and extrapolating it to the year 2000 results in an estimated electric energy demand of 6.5 trillion Kwh for 4% growth rate in GNP and 5.5 trillion Kwhr for a 3.5% growth rate. Searl's best estimate is 6.1 trillion Kwh in 2000 and 10.6 trillion Kwh in 2020.[43a/] This latter number is to be compared with 7.1 trillion Kwhr, the NRDC base case estimate and 10.6 Kwh, the AEC's base estimate.

Clearly, NRDC's base case estimate is not "very low" as the AEC would suggest. Rather it is higher than current projections, including those which are based on the most important economic factors influencing energy demand, namely, price of electricity, growth of the population and growth of income. We would, in fact, prefer a lower electrical energy

43a/ Op. Cit., p.12.

demand, particularly one which reflects a lower growth rate between now and 2000, but a lower curve was not considered by the AEC.

E) Growth in the Rate at Which Conventional Reactors Penetrate the Nuclear Market: We use the AEC assumptions that HTGR and LMFBR capacity fractions are constrained to follow the projections in WASH-1139(72), the projections made by the AEC's Office of Planning and Analysis in 1972.

We are forced to use this assumption because more realistic capacity fractions were not considered in combination with the assumptions we have selected above for capital costs, electrical energy demand, and uranium supply. A much lower rate of market penetration much less favorable to the LMFBR would be more consistent with the recently experienced reactor cancellations and stretched-out schedules. In fact, the AEC states:

> "During the short period since the Draft Statement was issued, however, some major changes have taken place in utility plans for added generating capacity. By the end of September 1974, U.S. utilities had cancelled about 12,000 MW of planned generating capacity and had deferred the initial operation of about

> 109,000 MW of previously ordered capacity (both fossil and nuclear) by about 2 years in most cases." 44/

According to the AEC this slippage has not been specifically factored into the various cases examined in the latest cost-benefit study. The AEC concludes:

> "The range of variables explored in the cost-benefit analysis as it now appears in this Statement (e.g. cases which assume a 50% reduction in the base case projection of electrical demand in the year 2020) appear to provide adequate insight into the possible effects of major uncertainties in the assumptions used, including the possibility of a few years' slippage in breeder introduction date."

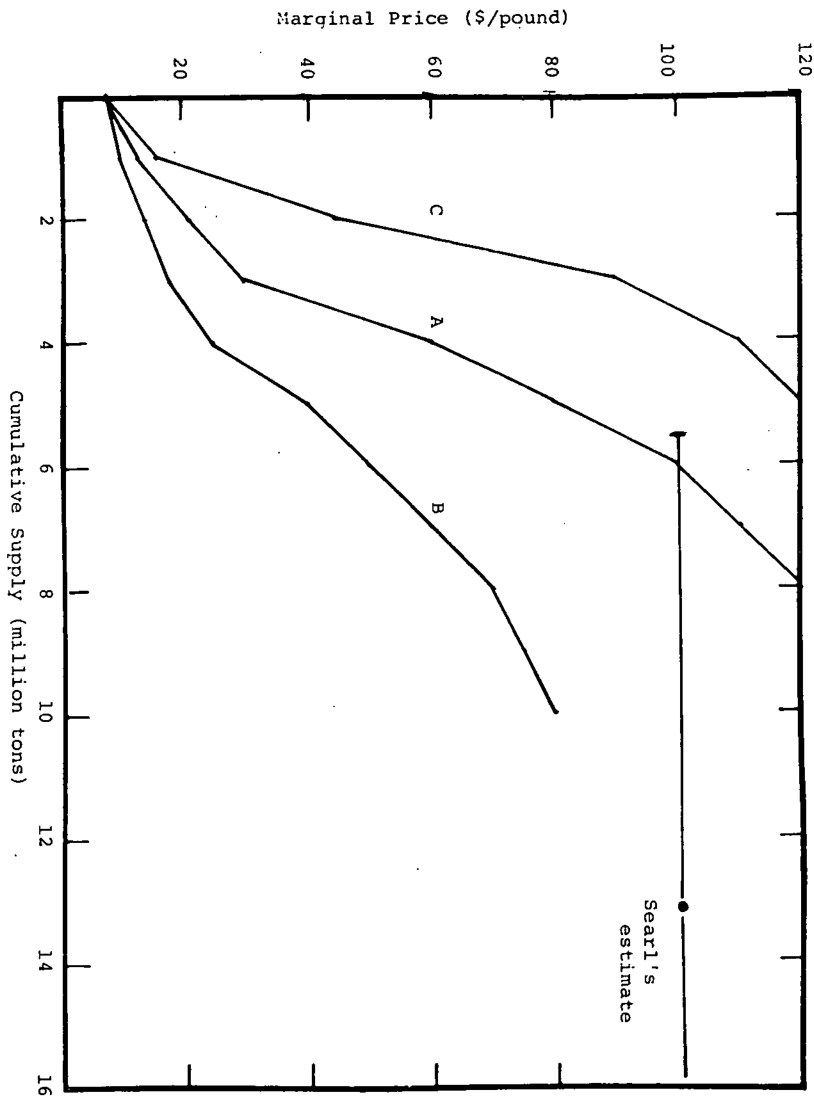
Here, the AEC is agreeing that our selection of NRDC's base case energy demand (Curve B in Figure 3) is the more appropriate choice of this parameter.

F) Uranium Supply: We use the curve labeled "B" in Figure 5.

This is the supply curve which the AEC considers "optimistic." The AEC base case is Curve A. We choose Curve B as our base case for several reasons.

44/ PFEIS, LMFBR Program, Vol.I, p.1.1-7.

Figure 5



Marginal Price of U_3O_8 versus Cumulative Supply

Source: Proposed Final Environmental Statement, LMFBR Program, U.S. Atomic Energy Commission, Vol.IV, p.11.2-72.

First, it most nearly corresponds to the estimate by the staff of the Energy Supply Studies Program, Electric Power Research Institute (EPRI) under the direction of Milton Searl. 45/ Searl estimated the domestic U_3O_8 resources in conventional deposits that could be recovered at less than $100 per pound. His estimates were presented as a function of his subjective probability that uranium resources will exceed a given value. Searl's best estimate (13.2 million tons at less than $100/lb) is plotted in Figure 5. The horizontal error bar represents his subjective probability at 68% confidence limits. (The high end of this error bar is off the graph to the right at 21 million tons). Searl believes his best estimate is actually conservative because it does not include additional lower grade (down to 0.1 percent) but still conventional ores. Time did not permit calculation of the lower grade resources which could be recovered for less than $100/lb and therefore these material's were not included in Searl's estimate above. 46/ Searl, however, estimates there are 3.8 million tons (at 90% confidence) of these lower grade ores in known producing areas and 14 million

45/ Electric Power Research Institute, "Uranium Resources to Meet Long Term Uranium Requirements," EPRI SR-5, Special Report (November, 1974), p.12.

46/ Ibid., p.6.

tons (50% confidence) in the entire United States.[47/] Of the 3.8 million tons in known districts, Searl believes probably somewhat less than the 2 million plus tons are likely to be recovered within the $100/lb cost range.[48/]

We share Searl's view that his estimates are most likely conservative. There are numerous examples where conservative assumptions have been made in deriving his estimates. For example, although the eastern United States and Alaska are potential sources of uranium, no credit is taken for this potential.

Searl's estimates of 13.2 million tons plus an additional several million tons in lower grade ores are to be compared with the AEC estimates of: a) 4 million tons of uranium in conventional deposits under their base case (Curve A) assumptions; and b) 6 million tons under their optimistic (Curve B) assumptions. Above these amounts the AEC believes mining of shale will be required.

The second reason we choose Curve B as our base case is that subsequent to the preparation of the uranium

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47/ Electric Power Research Institute, "Uranium Resources to Meet Long Term Uranium Requirements," EPRI SR-5, Special Report (November, 1974), p.9.

48/ *Ibid.*, p.81.

supply and price projections used in the AEC's cost-benefit study, the AEC apparently has identified an additional 1.2 million tons of domestic uranium resources in conventional deposits at less than $30/lb. The new total, 3.45 million tons, is a result of the Preliminary National Uranium Resources Evaluation Program (PNURE), started about 2 years ago.[49/] There is no mention of these data in the PFEIS of the LMFBR Program.[50/] The new total, in fact, is larger than the AEC's base case estimate (Curve A) of the cumulative supply at less than the same $30/lb price. It is almost 50 percent greater than the AEC's estimate of the domestic uranium resources made in January 1974, just over a year ago -- the older estimate forming the basis for the uranium supply projections in the PFEIS.

Third, there appears to be general agreement with the view held by the National Petroleum Council, that

> "Substantially all of the present proved reserves and approximately 85 percent of the potential reserves as determined by AEC are located in the

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49/ U.S. Atomic Energy Commission, "Report of LMFBR Program Review Group,"(1974), Fn.5, p.16.

50/ *See*, for example, Sections 6A.11.2, 6A.1.1.8, 6A.1.1.9, 11.2.1.2, 11.2.3.7., at the PFEIS, LMFBR, U.S. Atomic Energy Commission. December, 1974 (Vols.I through IV).

> presently producing areas, yet these areas make up less than 10 percent of the total region in which uranium occurrences are found--and even the producing areas in many cases are not completely explored."51/

There is little compulsion on the part of mining companies exploring for uranium to leave the proximity of the known producing districts as long as ample exploration opportunities to fill current demand are available. This would suggest there is ample low cost domestic uranium to meet anticipated need without the LMFBR until well into the next decade, much of it in these unexplored regions. A primary basis for the AEC's low estimates of domestic uranium resources and for rejecting the conclusions that exploration outside known districts will be very fruitful is that, "Geologic information and experience indicate that the present producing areas, which were located over a decade ago, are geologically, the most favorable for uranium. 52/ To our knowledge, no supporting basis has ever been given for this conclusion. The counter argument as expressed by Searl is:

> "There is even reason to believe that the nation may not yet have found its best deposits of uranium. It would

51/ National Petroleum Council, U.S. Energy Outlook--Nuclear Energy Availability, (NPC, 1972), p.6.

52/ PFEIS, LMFBR Program, U.S. Atomic Energy Commission. December, 1974, Vol.IV, p.11.2-74.

> have been somewhat fortuitous if the nation's best deposits were so conveniently placed that they were relatively easy to discover early in the history of uranium exploration." 53/

The AEC cites as supporting evidence for its uranium resources estimates the result of an evaluation of the uranium in the San Juan Basin of New Mexico using the Delphi technique. The problem with this analytical technique is that companies wishing to discourage exploration by competitors submit low estimates of the resources in those locations. Where companies are trying to attract developers, high estimates are submitted. A geologist and manager for exploration of one of the largest uranium companies in the San Juan Basin pooh-poohed the whole idea and refused to participate in the AEC's Delphi survey.

The AEC correctly notes, that in the matter of U_3O_8 sales prices versus supply, their base case estimate of price "errs on the low side of reality," and "does not reflect the more recent rapid escalation in prices in the U.S. market." 54/

53/ Electric Power Research Institute, "Uranium Resources to Meet Long Term Uranium Requirements," EPRI SR-5, Special Report (November, 1974), p.28.

54/ PFEIS, LMFBR Program, U.S. Atomic Energy Commission. December, 1974, Vol.Iv, p.11.2-75.

According to Jack Mommsen, of the Nuclear Exchange Corp.:

> "Rapidly rising prices were the dominant element of the uranium market in 1974, as prices for delivery in the years 1975 through 1980 rose an eye-popping average of 105 percent. By year's end purchasers were bidding \$15 per pound U_3O_8 for immediate delivery and \$25 for delivery in 1980. Power plant delays had no discernible effect on prices because European buyers picked up the slack created by reduced domestic demand.
>
> "The 1975 outlook is for a continuation of high prices for deliveries in the 1970's; an expected increase in the transaction tails assay should add some upward pressure. However, more uranium will be brought into the market; new sellers will enter; and withdrawn sellers will return--all beneficial effects of the lofty price structure. The post-1980 market remains uncertain, since most producers will not sell that far in advance." 55/

The total uranium commitments as of January 1974 were equivalent to about one-half the proved resources at less than \$10/lb. Hence, these recent price increases are not a reflection of the resource base but rather a shorter term response to market conditions. In the several years prior to 1973 the uranium market was soft. The combination of projections of large uranium commitments questions the uranium industry's capability to rapidly

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55/ Mommsen, Jack, "Mommsen on the uranium market," Nuclear News, Mid-February, 1975, Vol.18, No.3, p.31.

expanded production to meet increased commitments, and the requirement of long-term enrichment contracts appears to have paniced the utility industry. Sales in 1973 shot up 300 percent in a seller's market, increasing commercial uranium deliveries and commitments 45,000 tons over the previous year. This is three times the commercial requirements in 1974 of about 14 thousand tons. Reluctance of uranium producers to overcommit themselves forced sales down to 15,900 tons in 1974, but strong bidding has kept the price up. While prices may not return in 1975 we do not believe recent prices reflect a long-term trend, but rather a shorter term response as the uranium market shifted from the buyer's market of the past several years when prices were deflated, to the seller's market of today. There is little reason to believe that prices will not return, although not to the same low values, as we return to more stable market conditions and a normal profit margin.

III. Results of NRDC's Cost-Benefit Analysis

Table 2 below summarizes the preceeding key input assumptions selected as NRDC's base case and presents for comparison the AEC's base case assumptions. The assumptions selected as NRDC's base case correspond to

Case 58 of the cases tested by the AEC. The results for this case are reproduced in Table 3. The additional cases shown in Table 3 show the effect of varying the more sensitive input assumptions discussed above about NRDC's base case values.

Table 2

Base Case Assumptions of Key Input Assumptions

	Base Case	
	NRDC	AEC
Discount Rate	10%/yr	10%/yr
R&D Cost (discounted at 10%/yr)	$4.7 billion	$4.7 billion
Capital Cost Differential	$100/Kw after 2000	zero after 2000
Energy Demand	Curve B(Figure 3)	Curve A(Figure 3)
Rate at which Conventional Reactors Penetrate the Market	constrained to follow Projections in WASH-1139(72)	constrained to follow Projections in WASH-1139(72)
Uranium Supply	Curve B(Figure 5)	Curve A(Figure 5)
LMFBR Commercial Introduction	1987	1987

As seen from Case 58(NRDC's base case) in Table 3, the discounted R&D costs are 10 times the discounted benefits of the program. For every ten dollars spent on the developing of the LMFBR, we will get one dollar in return. This is hardly what one would term a worthwhile investment. We

Table 3

Summary of Cost-Benefit Study Results Discounted at 10%/Yr. To Mid-1974

Case[a]	Constraints Imposed Until (HTGR)	Constraints Imposed Until (LMFBR)	LMFBR Introduction Date	LMFBR Capital Cost Differential[b]	Electrical Energy Demand Curve[c]	Uranium Supply Curve[d]	Comparison With Case	Energy Costs	Billions of Dollars: Gross Benefits	R&D Costs	Net Benefits	Benefit/Cost Ratio
5	2020				A	B		201.4				
48	2020				B	B		148.1				
58	2000	2000	1987	$100/Kw	B	B	48	147.7	0.4	4.7	-4.3	0.08
55	2000	2000	1987	$100/Kw	A	B	5	196.6	4.8	4.7	0.1	1.0
52	2000	2000	1987	$ 0/Kw	B	B	48	144.2	3.9	4.7	-0.6	0.8
62	2020			$100/Kw	B	C		157.3				
72	2000	2000	1987	$100/Kw	B	C	62	150.6	6.7	4.7	2.0	1.4

Notes:

a) Numbers refer to AEC identity of cases in the PFEIS.

b) Capital Cost differential after 2000, corresponding to the curves in Figure .

c) Letters correspond to curves in Figure . Curve B corresponds to NRDC "base case," Curve A corresponds to AEC "base case."

d) Letters correspond to curves in Figure . Curve B corresponds to NRDC "base case," Curve A corresponds to AEC "base case."

Source: PFEIS, Appendix IV.D

arrive at this result even though our base case contains a number of assumptions that are highly favorable to the LMFBR. As noted previously, NRDC's base case assumptions pertaining to the capital cost differential, energy demand, market penetration by conventional reactors and uranium supplies represent selections of those parameters that are more favorable to the LMFBR than we believe realities justify. Our selection was limited by the cases considered by the AEC. Furthermore, we have used the AEC's estimate of the R&D costs, and have not considered additional cost overruns in the R&D program. We have not included first-of-a-kind costs associated with early commercial size LMFBR's or the costs due to the learning effects which Bupp and Derian suggested "could easily turn out to be a substantial multiple of research and development costs." We have used reactor performance characteristics assumed by the AEC. These characteristics represent program goals that we submit are unlikely to be achieved.56/ The characteristics of the advanced oxide LMFBR, for

56/ See, "NRDC's Comments on the DRAFT Environmental Impact Statement of the LMFBR Program." Reproduced in PFEIS, LMFBR Program, Vol.VI, pp.38-222 to 38-230. (December, 1974).

example, assumed to be available in 1991, are based on a design that optimizes performance at the expense of safety considerations, could not be licensed today and has been shown to be infeasible due to stainless steel swelling of the fuel cladding.

We are now in a position to examine the sensitivity of our base case assumptions to changes in some of the key input assumptions. As noted previously, we are severely constrained in this part of our analysis because we are limited by the cases tested by the AEC. Turning first to energy demand, it can be seen by comparing the results of Case 55 to Case 58 in Table 3, that the electric energy demand would have to grow at the "historical" rate assumed by the AEC to get a break-even benefit/cost ratio of 1.0. Similarly, corresponding to Case 72, one would have to assume a very unrealistic uranium supply curve (Curve C in Figure 5), before the benefits begin to exceed the cost. This unrealistic uranium supply curve was termed "pessimistic" even by the AEC. The AEC's report made this judgment before identification of the additional 1.2 million tons of low cost uranium, at less than $30/lb which was not included in their base case estimate. (See discussion on pages 34 -35). Finally, as shown in Case 52, reducing the capital cost differential to zero by 2000, other assumptions remaining unchanged from NRDC's base case, still leaves the benefit-cost ratio less than one. Again, for reasons stated above, these cases all contain assumptions highly favorable to the LMFBR.

In sum, when assumptions based on the work of expert authorities outside the AEC are used, the LMFBR program simply cannot be justified economically. Only when a series of highly unrealistic assumptions are made does the analysis suggest that the LMFBR program will produce economic benefits.

The AEC's base case, reproduced in Table 2, is an example of such a series of highly unrealistic assumptions. Here the gross benefits are $19.4 billion, against $4.7 billion in R&D costs. Due to the recent reactor differrals and cancellations, even the AEC has abandoned the base case energy demand projection. As noted previously, (see discussion on pages 30-31), the AEC now believes that "cases which assume a 50% reduction in the base case projection of electrical demand in the year 2020 appear to provide adequate insight into possible effects of major uncertainties in the assumptions used." The AEC has also abandoned the 1987 date of commercial introduction as evidenced by the AEC's statement:

> "Recent evaluations of the LMFBR development program by the AEC taking into consideration cancellations and deferrals of generating capacity by electric utilities that had occurred by the end of September suggest that the commercial LMFBR introduction would probably occur in the early 1990's." 57/

A date of commercial introduction in the 1990's, as opposed to 1987 is also more consistent with the history of slippages in the LMFBR R&D schedule. The effect of these changes on the AEC's results is extremely significant. Figure 6 shows the effect on the gross benefit for changes in the electric energy demand where the energy demand is plotted as a function of the rate of consumption in the year 2020. The two curves are for different assumed dates of commercial introduction of the LMFBR, namely, 1987 and 1991, and have been extrapolated to the electric energy demand corresponding to Curve B (50% reduction in the AEC's

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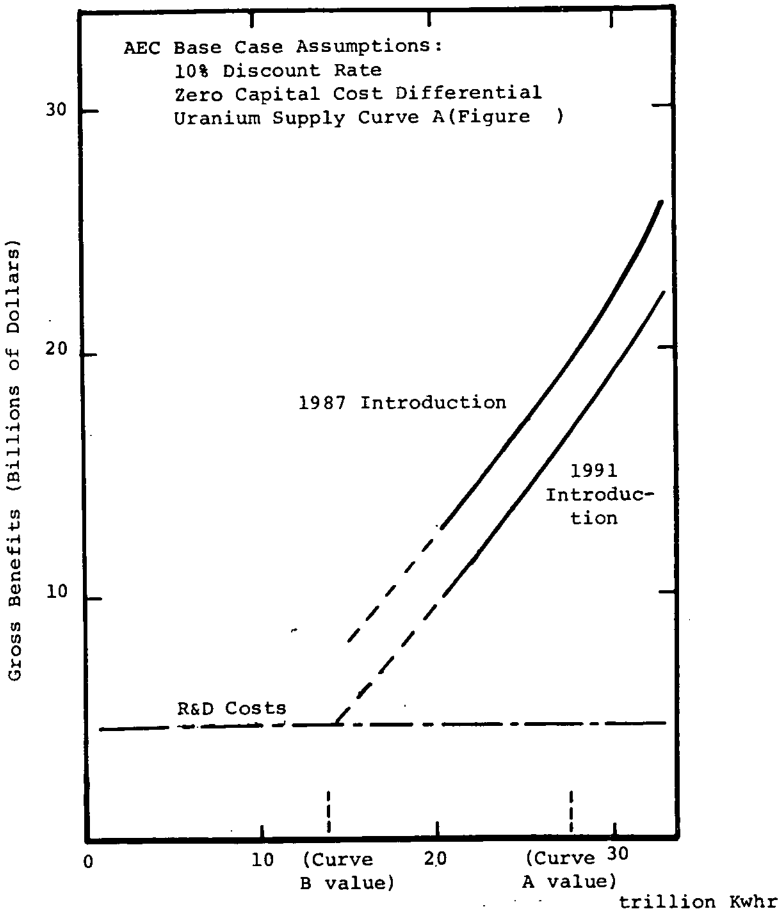
57/ PFEIS, LMFBR Program. U.S. Atomic Energy Commission, December, 1974. Vol.IV, p.11.2-134.

Figure 6



U.S. Electric Energy Demand in the Year 2020.
(Curves A and B Refer to Projections in Figure 3)

Sensitivity of Breeder Benefits to Energy Demand and Commercial Introduction Date Using AEC Base Case Assumptions for other Parameters base case projection -- Curve A). All other assumptions correspond to AEC base case assumptions in Table 2.

As can be seen from Figure 6, the gross benefit for 1991 commercial entry is roughly equivalent to the R&D costs, in other words, a breakeven benefit/cost ratio of 1.0. Similar results can be obtained by a slightly different procedure. For most of the cases considered in the benefit-cost analysis the AEC used projections of nuclear capacity by plant type given in the report WASH-1139(72),[58/] a 1972 projection by the AEC's Office of Planning and Analysis. WASH-1139(74)[59/] contains the most recent projections by this Office. Case A energy projection from WASH-1139(74) more nearly corresponds to the current status of the nuclear industry today. Case A assumes that delays in bringing nuclear plants on line continues to plague the industry and forecasts 85,000 MWe of nuclear generating capacity to be on line at the end of 1980. This is slightly higher than current estimates in the range 60,000 - 70,000 MWe. Using

58/ Forecasting Branch, Office of Planning and Analysis, U.S. Atomic Energy Commission,"Nuclear Power 1973-2000," WASH-1139(72). (December 1, 1972).

59/ Office of Planning and Analysis, U.S. Atomic Energy Commission, "Nuclear Power Growth 1974-2000," WASH-1139(74). February, 1974.

the WASH-1139(74) - Case A assumptions and changing no other assumptions from the base case assumed by the AEC (Table 2), the gross benefit is $5.1 billion, only slightly exceeding the AEC's estimate of the R&D cost. This small net benefit will be eaten up by a few years of cost overruns in the breeder program.

In sum, by the AEC's own reckoning, the breeder program can no longer be justified economically.

The question remaining is when could the LMFBR become commercially competitive with conventional reactors. Put otherwise, assuming that one favored developing the LMFBR, what should be the target date for achieving its commercial introduction? This question cannot be answered exactly, but the preceding discussion permits an informed estimate.

The poor performance of the LMFBR in the foregoing analysis stems from the fact that during much of the period of the analysis (1987 to 2020) the LMFBR cannot compete economically with other sources, so that only a limited number of LMFBRs are constructed. LMFBRs become economical only when the LMFBR-LWR capital cost differential of $100/Kw is offset by savings in LMFBR fuel costs over those of the LWR due to the increasing price of uranium. In order to offset a \$100/Kw capital cost differential the price of uranium would have to increase to about \$35/Kw.[60/] But according to our base case uranium supply curve (Curve B in Figure 5), this price will not be realized until the uranium commitment reaches about 4.5 million tons of U_3O_8. This commitment will not be reached until about 2020 assuming no LMFBRs are built and NRDC base case assumptions. Since it is the levelized cost of power over the lifetime of the plant and not the cost in the year of commercial introduction that determines when a plant is economically competitive, it is reasonable to expect the breeder to be competitive with conventional plants several years prior to 2020. Assuming it is competitive 10 years prior to this date, i.e., in about 2010, it follows that the appropriate LMFBR date is some two decades beyond the date established by the current LMFBR research and development schedule.[61/] A better estimate of the commercial entry date is available from the AEC's cost-benefit

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60/ "NRDC Comments on WASH-1535, Re Cost-Benefit Analysis," PFEIS, LMFBR Program. U.S. Atomic Energy Commission (December, 1974), Vol.VI, p.38-192.

61/ Others have reached a similar conclusion. See, e.g., David J. Rose, "Nuclear Eclectic Power," Science (April, 1974), p.357.

computer model which gives the commercial entry date for each reactor for each case analyzed. While this information for Case 58 was not provided in the PFEIS for the LMFBR program, we have been advised that after the constraint on LMFBR construction (through the year 2000) is lifted, the computer model projects that no LMFBRs are constructed until 2019.

Chairman HUMPHREY. Next we have Mr. Thomas R. Stauffer, director of the department of economics, Harvard University, to discuss the economic assessment.

Mr. Stauffer, I am sorry we kept you waiting all this time, I am not sure that putting four panel members on at the same time is the wisest use of your time. I have mentioned this to our staff when we planned these meetings.

We will listen to you and maybe we will have a few moments here to cross-examine.

STATEMENT OF THOMAS R. STAUFFER, RESEARCH ASSOCIATE, CENTER FOR MIDDLE EASTERN STUDIES, HARVARD UNIVERSITY

Mr. STAUFFER. Thank you, Mr. Chairman.

I teach energy economics and mineral economics at Harvard but I was originally trained as an energy physicist and after some years in the real world I returned to the university.

Chairman HUMPHREY. We will include all of the materials that you have provided as well as the full text of your prepared statement and I would appreciate it if you could, like others, highlight your testimony and summarize it.

Mr. STAUFFER. Yes, I have excerpts of material from my prepared statement.

I guess I am what you would call a reluctant advocate of the breeder. Reluctant in the sense that in looking at the other alternatives available it emerges as the less attractive of the options.

What I would like to focus on is the logic for proceeding with the development of the breeder recognizing there is a key distinction here between the decision to develop the breeder and the decision to ever have to build them. The second would need to be carried out only contingent upon better information that would be available hopefully 5 to 10 years in the future.

The conclusion we have come to from our economic analyses is that there is a fairly compelling economic argument justifying the R. & D. effort itself. We also recognize that the assessment hinges upon several imponderable uncertainties which I will come to in a second.

There are a number of noneconomic factors which all of the speakers have mentioned. The fact that the breeder is not a consummate ideal but simply a less bad alternative. For example, one option which has been mentioned is that we need no more energy. We have a moratorium on energy growth and consumption. These people I suppose one might call the apostles of poverty.

In particular one has to be wary of the forecast for conservation as an alternative for developing additional energy supply. In two different ways.

First of all, the ideal form of conservation is an economic recession. Indeed, today people are using less energy and we are also less active economically. Without even looking at the percentages which can be quoted as to what might be possible, one has to worry about the base.

There is an old Balkan proverb that half a goat is worth more than all of a chicken. One has to be worried very much about what the 10 percent or 30 percent or 50 percent referred to—maybe to a political high level projection.

When we look at the future needs of a breeder and we assume there is some future need for energy in our economy, we have to recognize all of the options available to us are in fact undesirable in one way or another. In the case of coal the disadvantages are obvious, it is messy to mine and to burn. In the case of nuclear reactors, there is some safety hazard. But if Professor Rose's calculations are correct, for example, there is a greater radiation emission from a coal fired plant than from a nuclear plant.

Chairman HUMPHREY. There is what?

Mr. STAUFFER. Professor Rose computed that the total emission from a coal plant is greater than that from a nuclear plant. This derives from the fact that all of the important coal deposits in this country contain a nonnegligible amount of uranium and this is emitted into the atmosphere. I don't want to belabor that but simply to illustrate that we are dealing with unattractive trade-offs here.

Indeed, the issue of whether or not we are embarking upon a component economy is also negligible because all of the reactors will produce some sort of waste that will be divertible. If one looks at the total plutonium in the U.S. economy under the assumption that no breeder versus the introduction of the breeder, the total change in plutonium is about 2 to 1.

Now, our analysis of the breeder, however, focused on the economic side rather than the intangibles, so let me go back to my principal thrust.

We tried to estimate the energy costs and perceived by consumers, and the total costs as perceived by the Nation. We eliminated oil and gas because they are scarce and would have to be imported. We focuser on coal, lightwater reactors, certain kinds of advanced converter reactors and the breeder.

The results of these conclusions were fivefold, and then I want to focus on the assumptions upon which these results depend very sensitively.

The first conclusion is already stated by Mr. Simpson, that we estimate the benefit to ultimate consumers' electricity on a discounted basis, somewhere between $70 and $100 billion. Looked at another way that is equivalent to a 40-percent reduction in the cost of electricity, which is nontrivial.

The third point is that the alternative of developing nonbreeders but more efficient converters does not affect the benefit of the breeder in any significant way. This is not an alternative to a breeder.

The fourth point that the benefits from developing the breeder are in fact significantly reduced if the breeder is delayed.

Now, from those results of the study we then draw three policy recommendations or conclusions.

First, that the development, and I underline that as distinct from construction, to develop the capability should proceed as rapidly as possible.

Second, paralleling that, should be some program to explore for uranium, to find out whether or not we actually need to build the things once we know how to.

Third, we recognize that 5 years from now we will have much if not all the information that is needed in order to decide whether a commercial construction program needs to go through. So that the two programs run parallel to each other and are complementary.

The key assumptions in this as in all cases turn out to be crucial. One is the assumption of electric growth and the other is uranium availability.

May I ask you to turn to the viewgraphs following appendix 4. Graph 3 shows the economic benefit as a function of uranium resources, we have to distinguish here in the United States between two kinds of uranium. We know that we have limited amounts of the very inexpensive stuff, we also know what we have virtually unlimited amount in this context of very expensive uranium. The uncertainty is what lies in between. That we don't know until we actually find it.

We refer here to the cheaper uranium. Based upon estimates of the AEC and ERDA, which contain 70 percent of reserves which have yet to be discovered, in other words the calculations upon which we have based our analysis already extrapolated the uranium supply by a factor of four into the unknown. The benefit of the breeder is about $70 billion. If one extrapolates those reserves by a factor of 6 over 7, then one ends up with a benefit of around $40 billion, still positive.

The intrinsic prospect here is that there is no way whatsoever for forecasting reserves. It has failed miserably in the case of oil and gas. We have seen in the last few years that our estimated reserves have been declining rather than increasing. We literally are not in a position to know whether the estimated resources of uranium at the present time are high or low. There is no scientific basis whatsoever for even judging whether they were high or low.

So what we have to worry about is the extent to which new resources might be found. But it doesn't help us very much to find high cost uranium in order for the economics of the breeder to be effective, in order for there to be an argument against developing a breeder. What we need to count on is a lot of very cheap uranium. That is much less likely but there is no way of knowing one way or another.

Chairman HUMPHREY. But you certainly do emphasize, in other words, the ERDA's extensive exploration operation for uranium sources?

Mr. STAUFFER. Yes. The expense of going out and looking for the stuff, even if it is not there, is sufficiently low compared to what is at stake here that broadly speaking it is eminently justified because we might be lucky. If we are lucky we can restrict ourselves to conventional reactors, if we are not lucky one can move ahead with developing the breeder so that we don't have to tear up and mine the very low grade high cost ores.

Chairman HUMPHREY. Would the Earth satellite have any application here?

Mr. STAUFFER. I think the answer to that is probably no, because the types of deposits which we might find will be deep enough that they are limited to no surface indication at al, so geochemical techniques would be important.

View graph 5 emphasizes the contrast between what we know we might have at the low end and what we know we have at the high end. The 2.4 million tons of uranium estimated to exist below $65, yet $65 is already a price for uranium at which the breeder is already competitive. At the high end, in the range of $72 million, we know we have 17 million tons of ore but at a price which already justifies the breeder. Again, I emphasize the question hinges upon what lies in between in this unknown.

We turn to view graph 6; it highlights the importance of cheap uranium in determining whether it is worthwhile to develop a breeder. Here we calculate the utility. The cost of uranium at which a breeder is justified.

For example, if the lifetime price for a reactor was $20 a pound, then one would be willing to pay a third more for a breeder over the plant cost for the reactor. If it were up to a $60 a pound, which may be what we are talking about within the next 16 years in this country, one would be willing to pay almost twice as much for a reactor.

So one could conclude that based on what we know today, that the breeder is already practical.

Chairman HUMPHREY. From an economic point of view?

Mr. STAUFFER. Yes. The present price for uranium is in the vicinity of $20, we know no reason to expect it to go down.

So the key question with regard to uranium availability is whether or not one can find large amounts of uranium in the range of $20 to $30 and that is a very stringent assumption.

I would like to throw in a comment on the question of laser separation, because I would like to suggest that the impact of it if successful is much les than has been suggested this morning.

That is over the next 20 or 30 years the conventional enrichment plants will use a lower percentage. They will extract more U^{235} out of uranium than they do presently. So even if one went down to zero extraction this would add about 1/6 maximum to the uranium supply which is equivalent to a couple of years requirement and that doesn't affect the basic balance.

Chairman HUMPHREY. In other words, the processing plants are more efficient and there is more U^{235} available, is that correct?

Mr. STAUFFER. I think your conclusion is correct but as prices go up it becomes more economical for the plant to extract more. But the conclusion is the same.

Chairman HUMPHREY. Yes.

Mr. STAUFFER. The second assumption is the matter of electric growth. We have taken for our base case a figure of 5.1 percent per year growth in electric demand. That hinges upon four assumptions which I want to identify that we can discuss later.

The first two relate to population growth and GNP per capital. We assumed the GNP would grow at 3 percent a year. That is part of a social objective and not a forecast.

With regard to the conservation and substitution of electricity for other forms of energy, we have run those two together recognizing that the price of electricity has in fact not risen as rapidly as other fuels, so that one has firm energy and economic reasons for expecting that electricity will take over the role of other fuels over the next 20 years.

In the testimony there is discussion of how this happens in the household heating plant which one might expect to be fully electrified by the end of the century.

So in GNP growth and conservation and substitution of fuels, I think one ends up with the conclusion that unless our economy does not grow we will take for an estimation on electric demand 5 percent a year. If it is lower than the benefit or argument for a breeder is lower but also vice versa, that is almost a policy target rather than an economic forecast.

Let me deal with two other parameters that affect the breeder program. The first thing I want to talk about is the delay question, and secondly the capital cost question once more.

Turning to graph 8, we have assumed that the breeder will begin to benefit the electric generating market in 1989. That is the year for which the $76 billion benefit is computed.

If the breeder could be brought on line 5 years earlier, the benefit is $11 billion greater. If the breeder is delayed by 10 years the benefit drops by some $30 billion. Again these calculations are contingent upon the assumption that there is uranium availability and electric demand. That must not be forgotten, they are sensitive to that.

So as far as our estimate is concerned, delay in the breeder program could be very costly indeed.

Finally, a note on the capital costs. We have computed, as shown on graph 9, the capital cost of the breeder and the benefit to the Nation, this is consumer benefit as distinct from utilities benefit, if the breeder plant cost 25 percent more than the regular reactor, then the benefit to the Nation is about $70 odd billion. But that number is misleading.

Parts of the plant for a breeder and nonbreeder are the same. So when you say the breeder plant costs 25 percent more than a regular reactor, we are saying that part which is specific to the breeder costs 50 percent as much. So, in a sense this understates the premium which is allowable.

Similarly, if we look at the case where the breeder costs 50 percent more, the benefit to the Nation is $50 billion. That implies that the nuclear steam production costs twice as much as the light-water reactor and at this point that seems to be a high upper bound given the differences in technology required.

So the conclusion that we come back to is that the insurance premium probably is worth paying and this is shown in an indirect way in graph 10.

When you look at how much coal and uranium would have to be mined in this country with a breeder this is another way of looking at the $76 billion benefit. The problem is if we don't find low cost high-grade uranium, we will be forced, already by the end of the century, to mine the very low quality shales in eastern Tennessee. The State of Tennessee may object to that, but that is a question that has to be faced in the future. Assuming they could be mined, their energy content per pound is the same as coal. So the amount of rock that has to be moved in this country would increase very rapidly. That is shown in graph 10, whereby we would have to be mining 6 billion tons of ore without a breeder as opposed to 3 billion with a breeder. That is another way of looking at the kind of cost savings which were calculated and discussed earlier.

Chairman HUMPHREY. This is based on a reduced demand of electricity in the range of what?

Mr. STAUFFER. This is based on the assumption that electricity will grow on the average of 5 percent a year.

Chairman HUMPHREY. I thought in your statement you thought it would be around 3 percent?

Mr. STAUFFER. That was 3 percent for the GNP and then calculations of the substitution effects indicate that for the 40 or 50 year period it is highly probable that the electricity growth rate would be some 2 or 3 points higher than the GNP, and somewhat still higher than the growth and demand for energy itself.

Chairman HUMPHREY. As I understand it, you are saying definitively that we should proceed with the development of the breeder.

Mr. STAUFFER. Yes.

Chairman HUMPHREY. And you feel within 5 years much of the information that we need as to whether or not we should go beyond development will be available, is that correct?

Mr. STAUFFER. Yes. In 5 years or so the uranium picture should be clarified and we may have a better idea of the electric demand and if we proceed with the commercial prototype of the breeder we will know whether or not we should go ahead and build them.

Chairman HUMPHREY. What is your benchmark judgment here beyond developmental? Do you think we will need to go to commercialization?

Mr. STAUFFER. That can be decided in better than a couple of years. The odds are probably 50/50 that we will need to do so because the uranium outlook is not that good.

Chairman HUMPHREY. If we get better supplies of uranium and there is a practical application of the laser technology to the waste, then we are in a much better position, are we not, to delay the breeder?

Mr. STAUFFER. Again I draw what is a vitally important distinction to the development program up to Clinch River and going beyond that.

Senator HUMPHREY. So any delay you are speaking of would be in commercialization if uranium sources are very abundant?

Mr. STAUFFER. That's correct.

Chairman HUMPHREY. So you believe we should go ahead with the Clinch River demonstration project?

Mr. STAUFFER. Yes, as rapidly as possible because of the possible consequences.

Chairman HUMPHREY. Now, I want to make sure that we have all of the exhibits in the record in proper sequence they include your prepared statement of appendixes 1 through 4 and graphs 1 through 10?

Mr. STAUFFER. Yes, Senator.

Senator HUMPHREY. All right.

[The prepared statement of Mr. Stauffer, appendixes 1 through 4, and graphs 1 through 10 follow:]

PREPARED STATEMENT OF THOMAS R. STAUFFER

I have been asked to discuss the economic cost/benefit analysis of the breeder reactor development program. I shall limit this formal presentation to summarizing a study which was completed quite recently in collaboration with two colleagues, Harvey Wychoff of Commonwealth Edison, and Roger Palmer of the General Electric Corporation. This report, together with certain supplementary materials, is annexed to this testimony and has been given to the Committee's staff.

Before developing the arguments pro and con concerning the economics of a nuclear breeder program, let me first state our conclusions and also identify the two crucial uncertainties which dominate any economic analysis of the breeder program, or indeed any other program for developing alternative sources of electrical energy.

CONCLUSIONS

1. The present gross discounted value of the economic savings from a successful breeder program lies between $70 and $100 billion (1975 dollars).

2. The undiscounted reduction in the costs of generating electricity, compared with potentially available alternatives, are $2.4 trillion ($75), or a saving of 41 pecent at the busbar.

3. This large economic advantage is not sensitive to other nuclear alternatives. such as converter or near breeder reactors.

4. The advantage is relatively insensitive to the capital cost of the breeder.

5. The economic advantage can be appreciably reduced by delays in its development.

From this technical-economic analysis, it is our policy conclusion that development of the breeder reactor must proceed without delay as a form of insurance against our nation's being caught with inadequate domestic supplies of cheap uranium. The consequences of being caught short are analogous to what has happened with regard to oil and gas supplies—dependence upon high cost imports, if available, and an expensive, accelerated scramble for high-cost domestic alternatives.

The second policy conclusion is that we should accelerate our program of uranium exploration, paralleling rapid development of the breeder. Uranium exploration and breeder development are necessary and complementary efforts—each is a hedge against the presently inadequate reserves. If exploration is successful, one might "bypass"—really only defer—construction of breeders. If exploration is not fruitful, we are covered and can stretch limited uranium supplies by a factor of 50-times by building breeders. Development of a viable breeder is best regarded as an insurance policy because one cannot predict with great accuracy the two central variables which control its economics—and the economics of the nuclear power industry in general. These crucial imponderables are:

1. The magnitude of U.S. endowment of low-cost uranium ($15–$20 per pound forward cost).

2. The projected growth in electricity demand over the next 40–50 years.

If Nature has indeed blessed us with well-concealed but abundant resources of low-cost uranium, or if the U.S. in fact will be able to prosper with only modest growth in electricity consumption—say 2 percent per year—then a breeder may be unnecessary or only marginally attractive. If we are so fortunate, then the insurance is unwarranted. However, the costs of delaying or foregoing the breeder option become very high if we today do not properly guess the future and the uranium forecasts prove to be overly sanguine or if the electricity demand exceeds the lower forecasts.

We should hope that we never will need to collect on this insurance policy, but that itself is no argument for not taking out the policy or for not paying the premium. Here, the insurance policy is the proven capability to construct commercial breeders in the 1980's—if needed, in the event that uranium is scarce. The premium for this insurance is the R&D effort of $6–10 billion over the next decade.

The insurable loss is the prospect of our having to mine 6 billion tons of coal and low-grade uranium ores each year after 2020, at great economic and environmental cost. Delay is costly because the known plus speculative cheaper uranium ores will already be dedicated to plants on line by about 1995.

Sensitivity calculations

Let us now examine the sensitivity of these results to the two key assumptions—uranium availability and electricity demand. Subsequently, we shall describe certain less important parameters.

Uranium supply.—This economic evaluation accepted the 1974 ERDA estimates for uranium supply, but we did convert ERDA's figures for "forward costs" into economic costs. The AEC geologists are presently best situated to make such an assessment of our uranium resources, and we saw no way to do any better.

The breeder economics are sensitive to uranium supply. This is to be expected since the breeder's primary advantage is its ability to use uranium 30–50 times more efficiently than light water reactors. Our base case benefit was some $76 billion. It presumes a tripling of known reserves below $60/lb.; if these are sextupled—if the base is doubled—the gross benefit from the breeder drops to $44 billion. Most of the reduced benefit derives from "new" resources in the $8–15/lb. class, yet current prices are already close to $20. which suggests that our "high" case for uranium may seriously overstate the existence of the cheaper ores.

We must note two points. First, two-thirds of the AEC estimated resources are undiscovered; these may or may not exist. Second, more than half of the indicated resources can be developed only at prices higher than the break-even value of uranium for the breeder.

A further general observation is important. There exists no reliable method whatsoever for forecasting future amounts of mineral resources, and it is risky to base policies upon such predictions. Our recent disappointment with regard to oil and gas is a sobering precedent. Until just a few years ago, various modifications of the "Zapp hypothesis" had been used to project that more than 400 billion barrels of oil remained to be discovered in the U.S. and on the OCS. This extrapolation promised domestic resources equal to 50 years or more of 1973 oil requirements.

The "Zapp-type" extrapolation of potential reserves were badly undermined by more recent research, and maximum potential oil resources are now estimated by most parties at around 100 billion barrels, not all of which is either discoverable or producible. Overly-sanguine forecasts of oil resources, using geological extrapolations, lulled us into an unwarranted complacency, and our domestic oil potential now appears barely sufficient to maintain present production levels, let alone displace insecure imports.

We must be wary of a parallel error in forecasting our domestic uranium resources. The methods cited by Tom Cochran or Irving Bupp, suggesting large amounts of uranium yet to be discovered, are based, explicitly or implicitly, on a Zapp-type extrapolation, analogous to that which seems to have failed so egregiously in the case of oil and gas. Although no proven method does exist for forecasting ore deposits, it is known that mineralizations are selective, and that there are preferred habitats for oil and for other minerals. These concentration patterns are quite specific to the geology and the geochemical history of each province, and to the chemistry of each mineral. Formulae, such as Milton Searl's "75-per-cent inter-regional-decline rule" are simply arbitrary and yield random answers, reflecting no chemical, physical, or geological principle.

Only extensive exploration can resolve the question of how much uranium can be found in any price category. But, as far as the economics of the breeder are concerned, the requirements are very much more stringent, since it does not suffice if large tonnages of $100-per-pound ores are discovered. Only high-grade ores affect the economic feasibility of the breeder. It is now expected that the breeder will cost some 20–30 percent more than an LWR. The table below, summarized from Annex No. 2, indicates that large volumes of very cheap uranium are necessary, at a price less than $20/lb. (or a "forward cost" of ca. $10–12) if the LWR is to remain competitive.

Uranium Price v. Breeder Capital Cost

[Cost ratio: LMFBR v. LWR]

Uranium price (dollars per pound):	
20	1.34
60	1.84
100	2.35

The LMFBR will be economically attractive to an electric utility, compared with coal or a conventional LWR, unless very large volumes of high-grade ore can be discovered.

Electricity demand.—We have assumed a growth in the demand for electricity of 5.1 percent through 2020, which yields a discounted consumers' benefit of $70–$100 billion from the LMFBR. The validity of this anticipated saving—equivalent to a 40 percent reduction in electricity costs—depends upon four projections:

1. Growth in population and workforce.
2. Growth in per capita GNP.
3. Efficient conservation in response to price.
4. Increased electricity consumption via substitution for fossil fuels.

I believe that electricity usage will continue to grow not at the historical rate, but still at some 2–3 per cent faster than the economy or total ends uses of energy.

Using a low projection for population growth (close to Series F) and the hope that per capita income will grow at 2 percent per year, we have assumed a real GNP growth of about 3.5 percent per year. This figure represents in effect a social target.

The third and fourth effects (above) are directionally compensatory. The real increase in electricity prices, compared with the general price level, has been comparatively modest and was dominated by electricity produced from oil and coal, against which nuclear power now competes still more favorably. Unfortunately, most of the recent decline in electricity consumption is due not to price-induced conservation but to "depression-induced" retrenchments.

Indeed, the electricity price effect will work backwards. Instead of "conservation" in the narrow sense, we must expect "conservation" in the broad sense, i.e. efficient substitution of electricity over the next decades, since electricity will be cheaper than alternatives. This will induce increased substitution of electricity in current applications for oil, gas, or coal. One important potentiality is the electrification of household and commercial heating using heat pumps. Even without breeders, heat pumps are less expensive than imported No. 2 oil or synthetic natural gas produced from scarce and expensive feedstocks. This market, equal to one-sixth of total end uses, could be captured almost completely through market forces.

Therefore, one must expect that the substitution effect will swamp the conservation effect, given the movements in relative prices against the alternatives and in favor of electricity. Thus, electricity demand will grow at a rate much greater than that of the economy. One such scenario is summarized below and described in Annex Four.

	Percent
GNP growth	3.0
Energy growth	2.4
Electricity growth	5.2

Consumption of secondary energy grows at six-tenths of a point less than the GNP, while electricity demand, on the other hand, grows at a rate almost 3 points higher than total demand for final energy.

If the economy does grow more slowly, existing uranium supplies will be depleted less rapidly, and the economic benefit from the breeder declines commensurately. A compound growth rate of 4.3 percent through 2020 reduces the benefit from LMFBR by $28 billion to $48 billion. Conversely, a growth rate of 5.9 percent implies almost doubling the consumers' benefit to $122 billion. We must believe in sustained low growth for the U.S. economy or in a heroic decoupling of economic and electricity growth before the gross benefit drops below $50 billion, but the value of the breeder is clearly most sensitive to our prognostication of the future course of the U.S. economy.

We can defer discussion of most of the other assumptions until later, insofar as the Committee might be interested. Let me cite only two.

Timing and delay.—Since our known and estimated low-cost reserves will be consumed by 1990, the introduction of the breeder is already "late". If it were possible to bring breeders on line in 1984, rather than 1989, the gross benefit would increase by $11 billion. A ten-year delay, on the other hand, costs not two billion but $3.3 billion per year. If the breeder is necessary at all, then all deliberate speed in development is warranted. The decision to replicate commercial plants can be taken later, in the early 1980's, when the economic case can be reviewed with better data on costs, technological progress, and uranium supply, but development must not lag.

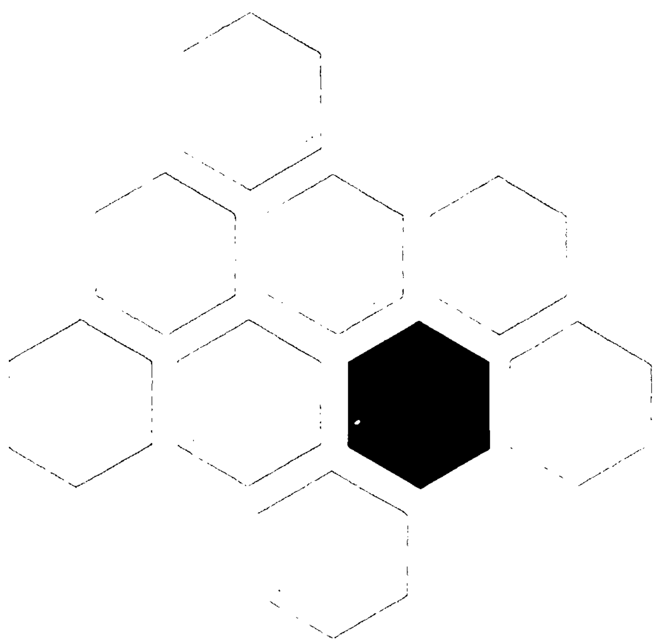
Breeder cost.—The benefits are relatively insensitive to the cost of the nuclear steam system for the plants. The base case assumes an LMFBR plant is 25 percent more expensive than an LWR, i.e. that the hardware specific to the breeder is 50 percent more costly. If the plant is 50 percent more expensive (the nuclear steam system twice as much), the benefit is reduced by $16 billion.

Recapitulation.—Given the central assumptions about future economic growth and the future supply of "low-cost" uranium (prices up to $80/lb.), the economic rationale for the breeder can be translated immediately into an argument for reducing future needs for mining—coal or low-grade uranium ores. Figure Four of Annex One displays the growth in tonnages of ore plus coal mined through 2020 with and without a breeder reactor. After the year 2000, mining requirements in the absence of a breeder rises precipitately to 6 billion tons per annum in 2020, about eight times the present level. Development of a breeder is the insurance policy we buy to forestall such a level of mining activity and the excavation of broad areas of western states or eastern Tennessee.

The uncertainties as to both costs and benefits are considerable and, unfortunately, lend themselves poorly to quantification. The risk of error in underestimating demand or overestimating uranium, weighed subjectively, seem more serious than the costs of the R&D effort. The costs of being wrong exceed the costs of insurance, and we conclude with the argument again that the breeder development program is an insurance policy which is worth buying.

APPENDIX 1

AN ASSESSMENT OF ECONOMIC INCENTIVES FOR THE LIQUID METAL FAST BREEDER REACTOR



THE LIQUID METAL FAST BREEDER REACTOR

Assessment of Economic Incentives

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INTRODUCTION

This paper assesses the economic rationale for continuing the national commitment to the development of a fast breeder reactor. The question, "to breed or not to breed" is multi-faceted, involving complex and conflicting considerations of cost, safety, and environmental impact for each competing electrical generation strategy. Here we shall focus upon estimating the savings in electricity costs which might ensue from the successful development of a commercial fast breeder reactor.

The central question for R&D policy is whether it is justifiable to commit the substantial additional funds — 5 to 10 billion dollars — to develop a commercial breeder through the construction of a demonstration plant and the first full-scale prototype plants necessary to foster commercial offerings in the power generation market.

It is crucial to recognize that the breeder reactor is only one of several options potentially available to the U.S. economy. The development of the current nuclear industry as well as past domestic and overseas breeder development has brought the breeder closer to commercial fruition than other advanced systems, but further R&D effort is still necessary before its commercial viability is established. One must also recognize that the rationale for developing a commercial breeder reactor capability does not necessarily commit the U.S. to install large numbers of breeders. The R&D effort serves to preserve and consolidate this one option. By the time that a successful full-sized breeder has been demonstrated, some of the presently imponderable uncertainties—such as the availability of low-cost domestic uranium, the relative investment costs of nuclear and fossil-fuel plants, and the long-term growth rate of electricity demand — will be better understood or at least partially resolved. Development of the breeder reactor thus is comparable to a premium paid for an insurance policy against otherwise uninsurable national risks. The breeder might not be needed — for example, extensive unknown and unanticipated deposits of high-grade uranium might fortuitously be discovered, in which case a breeder capability would be of reduced importance. However, we indicate below that the long-term economic costs of any *overestimate* of uranium availability would be very high — which suggests that a risk minimizing energy strategy should be designed.

Assessment of the breeder program is particularly awkward because the potential economic advantages are strongly dependent upon our ability to forecast three intrinsically uncertain environments.

1. **Technological Forecast**
   The relative capital cost of a breeder versus either more conventional reactors or fossil-fired stations remains uncertain. Although an upper bound of the breeder cost penalty can be postulated, extensive development work and some operating experience is needed for confirmation.
2. **Uranium Resource Base**
   Geological uncertainty renders any forecast of the availability of *low-cost* uranium quite speculative. This resource base uncertainty is intrinsic, and it can be reduced only with time-consuming and costly exploratory effort. There may be more "high" grade (>0.1%) uranium ore than is currently projected, but there also may be less.
3. **Economic Projection**
   Given the uncertainty in the total U.S. endowment of high-grade nuclear fuel materials, the need for a breeder reactor is sensitive to the projection of electricity demand. This in turn is intimately dependent upon both a projection of economic growth and some insight into any structural changes within the economy or patterns of inter-fuel substitution.

Forecasting in any one of the three above areas — technology, resource endowments, or economic growth and structural change — is notoriously difficult and unreliable, yet evaluating the potential for breeder reactors requires simultaneous forecasts of all three. The resulting compounded uncertainties bedevil the analyst as well as the policy-maker.

An additional feature peculiar to this problem is the tripartite participation by government, utility investors, and beneficiaries (electricity consumers) from the breeder program:

1. Public funds, from taxes or government borrowings, are enlisted to finance the R&D efforts.
2. Private sector funds will be mobilized by the electric utility industry to construct the plants. Rate regulation restricts these firms to a maximum allowable rate of return.
3. Consumers will garner whatever benefits result in the form of reduced electricity rates, since the electric utilities must flow any cost savings through to the customer.

The discount rates applicable to the three different parties are necessarily different. The rate to be used for the government must reflect the opportunity cost of investment displaced from the economy in general, while that for utilities refers to that industry specifically. Consumers, for whom the savings in electricity rates represent increased after-tax, disposable income, apply a still different discount rate. Accordingly, the cost-benefit calculus must be framed more generally, since the techniques appropriate separately to either governments, corporations, or consumers cannot be used as such for the whole program.

ALTERNATIVES

Many electric power generation alternatives must be considered in assessing national development priorities. First, two major sources — oil and natural gas — can be eliminated from further consideration because of clearly limited domestic supplies and the goal of national energy independence. Several other alternatives are available now and an additional few could be available in the coming decades.

Today, utilities can choose between coal, light water reactors (LWR's) and high temperature gas-cooled reactors (HTGR's). In the future, other nuclear systems termed advanced converters, such as the advanced HTGR or advanced CANDU reactor, could significantly penetrate the power generation market. In this analysis the relative advantages of true breeders and these other near-breeders were evaluated by selecting an advanced converter with a conversion ratio that results in uranium needs as low as now appears achievable in any of the conceivable concepts. The benefits of the breeder reactor were then assessed for various levels of commitment to these advanced converters.

Finally, longer-term options such as solar and fusion power were considered. Both fusion and solar offer potentially large amounts of energy. But the ultimate environmental and economic costs of both are uncertain. The feasibility of controlled nuclear fusion remains to be demonstrated and when it is, successful commercial development will still be many decades away. Nevertheless, the possible development of commercial fusion power after the turn of the century was considered in the analysis by terminating fission and fossil plant construction at the year 2020. Then fusion or any other system could significantly penetrate the market and not affect the results of this analysis which only considers utility system expansion through 2020.

Solar power, the remaining serious alternative now apparent, is one of many low-grade potential energy sources. Solar power, like the breeder, will require significant development funds before large scale commercial installations are feasible and competitive. Without significant technical breakthroughs, solar energy will likely be limited to low energy level applications, such as space and water heating, predominately in arid southern localities. For these reasons significant solar contributions to electric power generation have not been included within the time period of this study — to 2020. Direct use of solar power or other suitable sources are also considered implicitly through the growth of electrical demand which declines in the long term when this form of substitution might be utilized.

METHODOLOGY

In any economic assessment of long-term alternatives, the assumptions determine the results. For this assessment, base parameters were centered in the range of informed opinion. Additional cases evaluate sensitivities to the more important assumptions. The net benefit of the breeder is determined by calculating future electricity costs to the nation for two scenarios: One, if the breeder is not developed — and the other — if it is. The difference in the present worth of the accumulated energy costs is the economic incentive for the breeder.

An analysis such as this must be based on past experience and projected actions of the U.S. electric utility industry. Hence, one important factor is how well the analysis simulates operational and financial utility industry techniques. Accordingly the computer code used in this analysis is programmed to select the types of plants to build in accordance with actual utility decision processes.

The computer model determines which plants are to be built by comparing the economics of each type of plant: LWR's, advanced converters, breeders, or fossil plants burning coal. Average fuel costs, including financing charges, are forecast and combined with annual charges for plant capital costs. Fuel costs are projected over the expected plant lifetimes and present worthed to the year of startup.

The forecasting of fuel costs and their effect on plant selection decisions is an iterative procedure. Once a pattern of nuclear and fossil additions is established for the time period of the study, the resulting uranium, plutonium and separative work consumption and price schedules are compared to those that were used in the original decision forecasts. Until these results and assumptions agree, the code continues to generate new forecasts. Once convergence is attained and the pattern of plant additions and fuel use is finally established, the code proceeds to total the capital and fuel costs for all nuclear and fossil power plants over their lifetimes until retirement. A comparison of cases with and without the fast breeder indicates the savings made possible by the breeder.

The accumulated energy costs are measured in terms of the basic national resources — labor and materials — with transfer payments excluded. Transfer payments do not represent real costs, but transfers, and are not relevant to the estimation of real social costs. Transfers include such items as income taxes and

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financing charges. With transfers excluded, investments such as plant construction costs, and nuclear fuel purchases are recorded as they occur.

The time period of this study has been chosen as the present until the middle of the next century — 2050. In any analysis such as this, the termination of the calculations at the end of the time period requires particular attention. The approach is to accumulate energy costs through 2050 but to build new plants only until 2020. Through this approach the initial capital costs and the lifetime fuel cycle costs of all plants are reflected fully.

BASE CASE ASSUMPTIONS

Electrical Load Growth

Future growth of electrical demand is uncertain. Historically, electrical demand has doubled every ten years — a rate of over 7% per year. Recently, the energy crisis has perturbed this pattern. Electricity consumption in the latter part of 1974 was approximately equal to that of one year prior.

For the base case, the rate of electrical load growth is 6% annually through the year 2000 and 4% annually from 2001 through 2020. This is consistent with demographic projections that the growth in the nation's labor force will decline from the present 2% + annually to about 0.3% by the year 2000 (U.S. BUREAU OF CENSUS SERIES "F" PROJECTION) and that labor force productivity will continue increasing at about 2% per year.

If 75% of total energy production is used to generate electricity in 2020, the base case electrical growth corresponds to an average total energy growth rate of 2.8% for the same 45-year period. For comparison, the growth rate of total energy has been about 3.8% annually during the past several decades. By the year 2000, 60% of total prime energy would be used for electricity production.

Some suggest that lower rates are likely in the near future. However, the size of the labor force to the turn of the century is essentially determined now. An energy growth rate of substantially less than 3% would probably imply a slower rate of improvement in our standard of living than we have seen in the past.

The effects of price elasticity have not been considered in this assessment. If the breeder results in lower cost electricity for the nation, electrical demand and the benefits of the electricity may be greater than if the breeder is not available, and the nation's productivity and standard of living could benefit further than is considered here. Unfortunately, the quantification of the price elasticity for electricity could itself be the subject of a comprehensive analysis. The fact that the benefit of the breeder (to the nation) can be magnified through the effects of price elasticity is recognized but has not been included.

Uranium Resources and Prices

The conservation of the nation's uranium resources in the context of a broad commitment to nuclear power is the fundamental rationale for developing the breeder. The economic argument thus hinges upon our ability to forecast the extent of future uranium supply and prices. Abundant, cheap uranium reduces or postpones the need for breeder reactors, while scarce or high-cost uranium implies a compelling advantage and need for breeders. The evaluation of U.S. resources involves two questions:

1. How much uranium might be discovered?

2. What is the expected economic cost of discovering and developing that ore?

Since high-cost uranium — $100 per pound U_3O_8 or more — is copiously available in shales, etc., the crux is the projected potential supply of the lower cost ores (less than, say, $50 per pound).

This analysis considers only domestic resources, excluding imported uranium, even though more ore exists outside the U.S. than within. Significant price reductions due to uranium imports are assumed to be unlikely. Exporters of uranium, if any, will strive to follow the example of the Organization of Petroleum Exporting Countries (OPEC), and must be expected to formulate and maintain pricing policies which tie the price to that of alternatives. Indeed, the paucity of potential sellers of uranium — which include possibly, Saudi Arabia — coupled with burgeoning global demand, suggests that uranium bargains are most unlikely.

Price questions aside, the availability of uranium in significant quantities on the international market may itself be questionable, and it appears that a viable nuclear power industry can be safely based only upon domestic uranium resources.

AEC and mining industry estimates of domestic uranium resources are based on both known reserves and expected but undiscovered resources in and around existing mining districts. Exploration activities throughout the geologically attractive areas since 1960 have not located any new districts, in spite of the fact that exploration effort since 1960 is three times greater than all cumulative exploration through 1960. Current estimates[1,2] indicate that a total of 2.4 million short tons of U_3O_8 in "high-grade" (0.1 - 0.3%) ore may be available at "costs" under $65/lb U_3O_8.* This estimate involves more than tripling presently known reserves, as shown below.

Ore Grade	Known Reserves Tons	Estimated Additional Reserves Tons	Total Tons	Probable Economic Cost ($/Pound U_3O_8) 1975 $
0.11 – 0.30% U_3O_8	275,000	450,000	725,000	$10 – 15
0.008 – 0.11%	425,000	1,250,000	1,675,000	$15 – 65
	700,000	1,700,000	2,400,000	

* The "cost" data reported by the AEC, "forward" costs exclude profits, income taxes, and any sunk costs of capital. If the excluded items are added, based on data from mine simulation studies, one finds that the economic cost is greater than the forward cost by as much as two times the reported "forward cost" for a given ore class. We refer here to economic costs (roughly equivalent to prices) unless explicitly qualified.

The next lower-grades of uranium resources in the U.S., ranking well below the conventional sandstone and conglomerate deposits, are the Tennessee shales.

The Tennessee — or Chattanooga — shales occupy a large part of eastern Tennessee, bedded in three layers beneath 150 feet of limestone overburden. Only the upper two layers are normally considered recoverable. The top layer is about seven feet thick and contains about 70 ppm U_3O_8, while the next layer is approximately eight feet thick and contains uranium in concentrations of 25 to 60 ppm. The top layer is estimated to contain nearly 5 million tons of U_3O_8, while the bottom may contain up to 8 million tons.

Recent studies indicate that, with stringent environmental standards, the actual price could be as high as $150 per pound when the two layers are mined together, or $126 per pound[3] for the top layer alone. This figure is significantly higher than the 1960 estimate of $50. The energy density of these ore deposits is quite low, *circa* 6,000 - 17,000 Btu per pound of ore, not including the overburden, and before the losses associated with the enrichment process.

For example, if the requirement of 140,000 tons of U_3O_8 forecast for the year 2000 were to be met with the higher-grade shales, it would require mining nearly 6 million tons of ore per day. That is four times the present rate of 1.5 million tons of coal per day.

The Conway Granites contain 20 to 40 ppm of uranium, and are thought to aggregate 25 million tons of U_3O_8, plus byproduct thorium, at costs greater than $200 per pound, plus environmental effects comparable to or worse than that involved in mining the Chattanooga shales. Lastly, in theory, billions of tons of uranium could be extracted from seawater, but the economics of this process are still remote, beyond even useful speculation.

All that is known with certainty is that adequate quantities of very high-cost uranium have been located and could be developed. The key question for the policy analyst is whether significantly more low-cost ores may be discovered and, if so, to what extent. This question, although central to any rational decision, is intrinsically unanswerable, because geological forecasting is still a less accurate tool than even economic forecasting. Reliable estimates of resources in a geological province emerge only when the province is near depletion.

Nonetheless, given that resource forecasts are necessary, it is tempting to estimate ultimate resources, such as uranium, by extrapolating forward known discoveries by the ratio of unexplored areas or depth horizons to the known areas. This approach, known as the "Zapp" hypothesis, was used by the U.S. Geological Survey to estimate ultimate reserves of recoverable oil and gas. Recent analyses has revealed the intrinsic upward bias in such extrapolations. Exploration is selective — so that the promising prospects are investigated first — and the returns of additional exploration effort decrease inexorably with time as the distribution of ore-bodies is selectively depleted.

What can be said about the likelihood of substantial new finds of low-cost uranium? Historically, the oil and gas industry found new reserves in the U.S. year after year, so there is precedent for some optimism. On the other hand, we know today that the domestic oil and gas industries can no longer sustain themselves, and declining production is inevitable. Thus any optimism induced by analogy must also be bounded.

Some circumstantial evidence suggests measured caution in projecting discoveries of low-cost uranium from its conventional habitats. First, uranium mining has grown at a precipitate pace, compared with oil and gas, so that the point of inflection in reserve additions should occur earlier. Diminishing returns are already evident today. The average depth of exploration boreholes has trebled since 1964,[4] while the discovery yield, in pounds of U_3O_8 per foot drilled, has declined from 9 to 3, in spite of intensified search after 1966.

The forecasts used in this analysis are shown in Figure 1. For a base, the extent

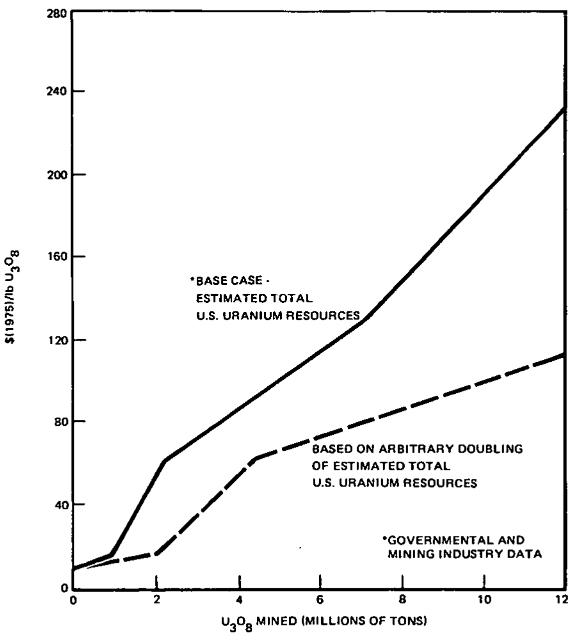

Figure 1. Projection of U_3O_8 Price versus Cumulative Consumption

of the low cost conventional ores was taken as 2.4 million tons up to a "cost" of \$65/lb U_3O_8. Additionally, as is discussed later, the effects of arbitrarily doubling the extent of these ores were also examined.

Inflation

In a rigorous economic assessment such as this, inflation will have no effect on the results. The model used for this assessment was exercised with several rates of inflation. This presented an opportunity to check the internal consistency of all calculations. The benefits of the breeder were found to be independent of the inflation rate.

The base case is presented with a 6% inflation rate because the various carrying charge rates appropriate for this rate are more familiar than the financial factors that would be appropriate to no inflation. Nevertheless, the rate of inflation does not change the discounted results.

Money Costs

Table 1 shows the coordinated financial assumptions that are used for investor owned utilities. The cost of debt and equity, as well as the debt/equity ratio are based on the industry's past experience. These values are used in a plant selection logic that is similar to that used by the utility industry.

Discount Rate for Energy Costs

The breeder reactor program, as well as other long-term programs for the development of alternative energy sources, poses a special problem in cost-benefit analysis. The three parties involved in (1) developing a breeder capability, (2) in constructing and operating the plants, and (3) in enjoying the promised savings in electricity costs — the federal government, the utility industry and the collectivity of all consumers of electricity — exhibit distinctly different discount rates. The opportunity cost of federal funds[5] should reflect the value of the tax receipts or borrowings as if the same monies had been retained by the private sector for consumption and/or investment, including the effect of income taxes foregone. The opportunity cost of money to the utilities is a weighted average of debt and equity costs. Finally, consumers' discount rates embody, at least conceptually, a weighted sum of lending rates (deferred consumption) and borrowing rates (accelerated consumption). Since the three rates differ, it is not self-evident which rate is appropriate to the cost-benefit calculus. Yet a time-discounting procedure is necessary.

A comprehensive analysis shows that four separate steps are necessary.

1. For each year, it is necessary to determine the future benefit stream which would have been generated if the investment funds had been

Table 1
Coordinated Financial Assumptions for Investor Owned Utilities[1,2]
(Used for Economics of Year-By-Year Plant Selection)

			Base Case
1.	Rate of inflation	0%	6%
2.	Cost of debt money for zero inflation	2.75%	2.75%
3.	Cost of debt money with inflation (1x2), e.g., [(1.06x1.0275)−1](100)=8.92%	2.75%	8.92%
4.	Cost of equity money for zero inflation	5.5%	5.5%
5.	Cost of equity money with inflation (1x4), e.g., [(1.06x1.055)−1](100)=11.83%	5.50%	11.83%
6.	Assumed debt/equity ratio for utility industry capitalization	0.55/0.45	0.55/0.45
7.	Assumed federal plus state tax at 50% of total earnings[3]	50%	50%
8.	Return on debt (cost for use of debt portion of money),(3x6); e.g., (0.55x8.92%)=4.90%	1.51%	4.90%
9.	(a) Return on equity (cost for use of equity portion of money), (5x6), e.g., (0.45x11.83%)=5.32%, and	2.48%	5.32%
	(b) Federal tax plus state tax (for 50% total tax on earnings)[3]	2.48%	5.32%
10.	(a) Effective interest rate (8+9)	3.99%	10.22%
	(b) Discount rate (8+9) for utility decision making process	3.99%	10.22%
11.	Level annual revenue requirement excluding depreciation (effective interest rate plus taxes) (10a+9b)	6.46%	15.54%
12.	Level annual revenue requirement with depreciation, 30-yr. book-life and 16-yr. tax life (determined by calculations using above assumptions — calculation not shown)	6.1%	12.03%
13.	Assumed property tax plus plant insurance	1.7%	1.7%
14.	Level annual revenue requirements with depreciation, property tax and insurance (12+13)	7.8%	13.73%

[1] The zero inflation financial assumptions are indicated to aid the reader in developing financial factors for other rates of inflation.
[2] The assessment uses financial assumptions appropriate to government owned utilities for their portions of the nation's electrical capacity.
[3] At 50%, assumed federal plus state tax is equal to return on equity.

expended elsewhere in the economy, rather than for breeder construction or for alternatives. The discount rate used to convert an investment into a stream of future benefits is the return on capital in the industrial, non-financial sector.

2. These streams associated with each year's outlay are summed over time, and the composite stream of foregone benefits is the opportunity cost of the resources committed to each of the programs.

   Thus, associated with each program is a stream of the benefits foregone if the program is undertaken. This is the "cost" of each program option, measured in terms of equivalent consumption. This measure, if computed correctly, incorporates the impact of reinvested benefits and thus represents the streams of final aggregate consumption. For conservatism in this paper, reinvestment of the benefits was disregarded. This effect would raise the benfits by 50% over a simple discounting and summation.

3. The net benefits from one energy option compared with another equal the difference between the full opportunity "costs" of each option, as defined above.

   The benefit thus is the reduction in cost, since the pattern of electricity generation is postulated to be the same for all alternative strategies.

4. The present value of the savings — i.e., the difference in costs between any two alternative strategies — is then computed using the consumption discount rate.

The prior steps lead to the transformation of all investment outlays into equivalent foregone consumption. Since the savings are thereby expressed in consumption equivalents, the consumption discount rate is appropriate. Opinion regarding its actual value is divided. In this analysis the upper bound of opinion was used — 6% per year — after correcting for inflation. For the base case, which uses a 6% inflation rate, this discount rate was actually 12.36% per year, the product of the two rates.

The absolute value of the net benefit, if any, measures the present worth of the additional consumption which accrues to all consumers and which is the contribution to the national economic welfare.

Plant Costs

Gross factors such as inflation, design evolution and learning curve economics can substantially affect accumulated energy costs. But, for an analysis such as this, where cases are being compared and differences assessed, the most important aspect of plant capital costs is the cost differences between competing systems.

For this analysis, the capital cost of LWR plants in 1975 dollars is assumed to remain constant at $385/kW_e ($600 in actual dollars for plants completed in 1982), including customer costs such as interest during construction. Coal plant capital costs are assumed to be $340/kW_e. The coal plant costs reflect requirements to meet environmental controls. The capital cost of the breeder in the base case is $480/kW_e which is 25% greater than that of the LWR.

Coal

The outlook for fossil fuel costs both in the U.S. and throughout the world also has elements of uncertainty. In this analysis the addition of significant numbers of new large electric plants fueled with either oil or natural gas has been taken as unlikely in view of expected shortages of natural gas coupled with the uncertainties in oil supply and cost.

Coal, however, is abundant domestically and could potentially supply much of our energy needs for many decades. But coal utilization is limited by environmental restraints. Although relaxation of environmental rules and new technologies could make significant amounts of coal available to the energy markets, in the long term, coal may eventually be allocated to raw material uses rather than as an energy source. Nevertheless, in this analysis coal use was assumed to be unrestrained, and dictated only by its economics.

The average new coal or gasified coal cost for the base case is 90¢/MBtu's in 1975, rising linearly to 135¢/MBtu's in 2020 (75 $). The national average cost in 1975 for those plants now in operation was assumed to be 75¢/MBtu's.

Breeder Performance

The breeder reactor that is used as a reference for this assessment has the following key characteristics:

Electrical Output	(MWe)	1000
Capacity Factor*	(%)	80
Overall Plant Efficiency	(%)	38
Breeding Ratio (at equilibrium)		1.25
Compound System Doubling Time (at equilibrium)	(years)	18.0
Specific Power (at equilibrium)	(kWt/kg – fissile)	900
$\frac{\text{Fissile out of Reactor}}{\text{Fissile in Reactor}}$		0.75
Fabrication and Recovery Losses	(%/Cycle)	2

* This capacity factor is used during economic evaluations for selecting plant additions each year. Actual costs and capacity factors in the assessment depend on actual plant loadings. Plants are loaded to meet the daily load swings in a manner that minimizes system fuel costs.

The fuel performance is achievable with oxide fuels without significant materials development. Eventual progression to more advanced fuels such as carbides is however possible and perhaps likely. However in this analysis, this further development as well as materials development for oxide cores was disregarded. If more advanced fuels prove successful after commercialization of the breeder, the benefits of the breeder to the nation would be greater than is shown in this analysis.

BASE CASE RESULTS

Without the Breeder

Without the breeder the computer code compares the economics of only coal plants and LWR's and construction decisions are based on the capital costs of the plants and fuel costs projected over the projected thirty-year plant lifetime. Initially in 1980 coal plant costs are $340/kW$_e$ (75 $) and total LWR costs — $385/kW$_e$. An advantage equivalent to approximately 0.9 mill/kW-hr for the coal units. However, the 30-year fuel costs — nuclear versus coal - are forecast to be 3.1 versus 9.6 mills/kW-hr, respectively, giving a net 5.6 mills/kW-hr advantage to nuclear. Correspondingly in 1980, 90% of the plant additions are nuclear. This advantage for nuclear power is principally due to the low costs of the Western U.S. uranium ores. These costs average $24/lb U_3O_8 (75 $) over the lifetimes of the LWR's starting up in 1980.

But in this case without the breeder, the high grade uranium ores are depleted by the turn of the century and after then the LWR's become completely dependent on the lower grade shales. In reality some of this dependence is even reflected in the fuel costs of the 1980 reactors, since they would operate through 2010, but due to present worthing, the effect was not large. However, by the year 2020 without the breeder, actual uranium prices have risen to $125/lb U_3O_8 (75 $) and forecasts predict an average reactor lifetime price of $170/lb for a plant starting up in 2020, while average lifetime coal prices have risen only to $1.55/MBtu's. At this time the economic advantages of nuclear power over coal would be reduced and nuclear startups would represent only about one-third of new capacity. In 2020 (Figure 2) the total of all installed capacity is 3289 million kilowatts (GW$_e$) of which 1972 GW$_e$ is nuclear and 1317 GW$_e$ is coal fired capacity. By 2020, annual nuclear fuel costs have risen to 11.5 mills/kW-hr (75 $) from 2.5 in 1980 and the total fuel bill to the nation is $136 billion (75 $) annually of which $40 billion is coal and $96 billion uranium plus other nuclear fuel costs. The present worth of the accumulated energy bill, from the present through 2050, when the last plant is retired, is $779 billion of which $280 billion is for capital investments and $499 billion for fuel costs.

With the Breeder

Alternatively, with the breeder, the competitive outlook for nuclear power and electric power fuel costs are more stable. By 2020, nuclear additions, principally the LMFBR, rise to 77% of the total market reflecting the economic attractiveness of nuclear power through low fuel costs made possible by the breeder. In 2020 (Figure 3), of the 3289 GW$_e$ of installed capacity, 2519 GW$_e$ is nuclear and 770 is coal. Of the nuclear, 1418 GW$_e$ is LMFBR's while 1101 GW$_e$ is LWR's and advanced converters. Fuel costs in 2020 are correspondingly reduced by 41% to $81 billion of which $11 billion is coal, $43 billion uranium and the remaining $27 billion other nuclear fuel costs. The accumulated fuel costs through 2050 discounted to the present are $393 billion, a savings of $106 billion relative to the case without the breeder due to the savings in uranium and coal expenditures made possible with the breeder. This advantage is illustrated in Figure 4 by the combined mining volumes of coal and uranium. Until the mid 1990's, the mining volume for the electric power industry declines as nuclear power using the high-grade uranium ores plays a greater role in supplying energy. During the 1990's though, it is necessary to turn to lower grade uranium ores and mining levels begin to increase. But in the case with the breeder, in 2020 mining levels are at 2.7 billion tons per year whereas without the breeder the level reaches 5.9 billion tons by 2020 and is still increasing rapidly. This is over 11 times today's level of about 500 million tons for the electric power industry. Had the analysis constructed plants past 2020, the mining levels in the case with the breeder would have soon leveled off and actually begun to decline as the advantages of the minimal mining requirements of the breeder are realized.

Returning to the energy costs, the additional capital costs of the breeder and the higher nuclear penetration are $30 billion, reducing the net cost savings to *$76 billion*. If the costs had not been discounted, but inflation alone factored out, the benefit would have been $2.4 trillion. The former value is the goal of the analysis, a measure of what could be spent today for breeder reactor development.

Sensitivity Analysis

The sensitivity of the breeder benefit to variations in the key assumptions is important. Four of the assumptions of particular interest are: (1) capital cost of the breeder, (2) uranium availability, (3) electrical growth rate, and (4) date of commercial introduction. These as well as the results from other sensitivity analysis are described in the following sections and summarized in Table 2.

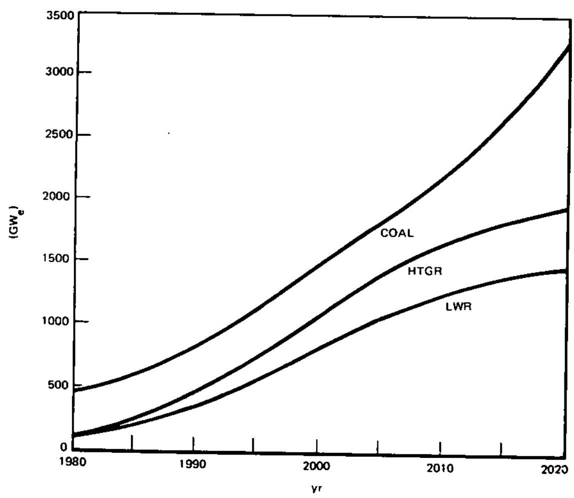

Figure 2. Installed Capacities Without the LMFBR

Table 2
NET BENEFIT OF BREEDER REACTOR TO NATION

			Net Benefit 1975 Present Worth $ Billions
1. Base Case			
Electrical Growth Rate	Years 1975-2000	6%	
	Years 2001-2020	4%	
Inflation Rate		6%	
Discount Rate, Without Correction for Inflation		6%	
Discount Rate, With Correction for Inflation		12.36%	
Advanced Converter as % of Non-Breeder Capacity		25%	
Uranium Price — Base (Figure 1)			
Coal Price for New Fossil Capacity — Base			76
Increases Linearly (1975 $)	Year 1975	90¢/MBtu's	
	Year 2020	$1.35/MBtu's	
Capital Cost of Coal Plant (1975 $)		$340/kWe	
Capital Cost of LWR Plant (1975 $)	($600/kWe in 1982)	$385/kWe	
Capital Cost of LMFBR Plant (1975 $)		1.25 x LWR	
Cost of Uranium Enrichment		$70/SWU	
Breeder Plant Efficiency		38%	
Breeder Introduction Date		1989	
Additional Cases Using Alternate Assumptions for the Parameters Noted			
2. Capital Cost of Breeder		1.5 x LWR	60
3. Capital Cost of Breeder		2.0 x LWR	31
4. Electrical Growth Rate	Years 1975-2000	7%	122
	Years 2001-2020	4.5%	
5. Electrical Growth Rate	Years 1975-2000	5%	48
	Years 2001-2020	3.5%	
6. Uranium Resources — Twice as Plentiful as Presently Appears Probable			44
7. Coal Price for New Fossil Capacity — Pessimistic Increases Linearly (1975 $)	Year 1975	$1.10/MBtu's	86
	Year 2020	$1.60/MBtu's	
8. Breeder Introduction		1984	87
9. Breeder Introduction		1999	43
10. Breeder Introduction		2009	19
11. Advanced Converter as % of Non-Breeder Capacity		10%	94
12. Advanced Converter as % of Non-Breeder Capacity		40%	59
13. Cost of Uranium Enrichment—1/2 Base Case		$35/SWU	76
14. LMFBR Fabrication and Reprocessing Costs Twice Probable			60
15. LMFBR Breeding Ratio		1.30	89
16. LMFBR Breeding Ratio		1.20	65
17. LMFBR Specific Power		700 kWt/kg Pu fissile	41
18. LMFBR Specific Power		1100 kWt/kg Pu fissile	100

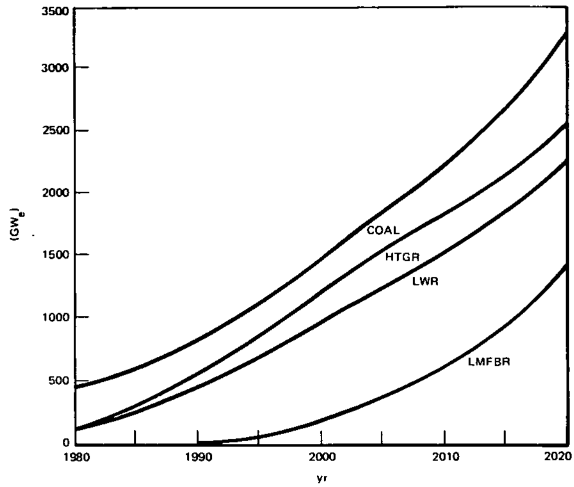

Figure 3. Installed Capacities With the LMFBR

1. **Capital Cost of the Breeder**
In the base case, the breeder's capital cost is 25% greater than an LWR's. According to this assessment, the present valued benefit of the breeder to the nation would still be $31 billion even if the capital cost of the breeder were two times that of the light water reactor. An LMFBR plant cost of this magnitude brackets the upper bound of informed opinion. Most of the added costs of an LMFBR over an LWR will arise in the nuclear part of the plant. In fact, the remaining conventional portion should prove less costly than an LWR's because of better steam conditions and correspondingly smaller equipment. Thus, an LMFBR costing twice the cost of an LWR represents an even greater difference between nuclear systems costs.

There are several reasons why the benefits of the breeder are so large even when capital costs of the breeder are very high. For one, soon after the turn of the century the nation may have to mine uranium ores whose energy content per pound is about equal to coal. This is about 1/50 of the energy content of the uranium ores being mined today. Thus, the benefits of the breeder indicate in a sense what the nation can pay to avoid greatly increasing its dependence on low grade energy resources.

An externality is a second reason for the large benefits of the breeder. Whenever a breeder is selected over a light water reactor, a plant lifetime supply of U_3O_8 is conserved and available to be shared by all other uranium fueled reactors. This helps defer the need to mine more costly ores and thus reduces the price of uranium for all reactors. This externality is not seen in conventional direct cost comparisons of an LMFBR and a competing reactor. However, this effect produces a substantial added incentive for the nation to utilize breeders.

2. **Uranium Availability**
One analysis was performed wherein it was arbitrarily assumed that the amount of all grades of uranium projected to be in the U.S. would be double present estimates.

Surprisingly the discounted benefit of the breeder is still $44 billion as compared to $76 billion in the base case. The principal reason the benefit remains large is that doubling the nation's uranium resources will defer the need to turn to lower grade uranium ores by only 10 years —from the year 2000 to the year 2010.

3. **Growth Rate**

The base case assumes annual rates of electrical demand growth of 6% between the year 1975 and 2000 and 4% between the years 2001 and 2020.

Two other cases were run with growth levels that bracket the base case. A summary of the cases related to variations in the levels of electrical growth is as follows:

Annual Growth Rate		Net Benefit 1975 Present Worth
Years 1975-2000	**Years 2001-2020**	**$ Billions**
7%	4.5%	122
6%	4.0% (Base)	76
5%	3.5%	48

4. **Date of Introduction of Breeder**
If the introduction of the commercial breeder is delayed to 1999, the benefit of the breeder drops to $43 billion, and if it is delayed to the year 2009 the benefit is $19 billion.

For the situation where the breeder is delayed some analysts attempt to designate separately by some means, the portion of the decline in benefits that occurs because fuels are more costly, and the portion of the decline that comes about because there is a shorter period during which benefits can accrue. The implication is that it is not proper to charge the latter portion to the delayed introduction. In fact, however, the period of the delay is real and the benefits that the breeder would have provided during that period are lost forever.

Delay of the commercial introduction of the breeder in combination with

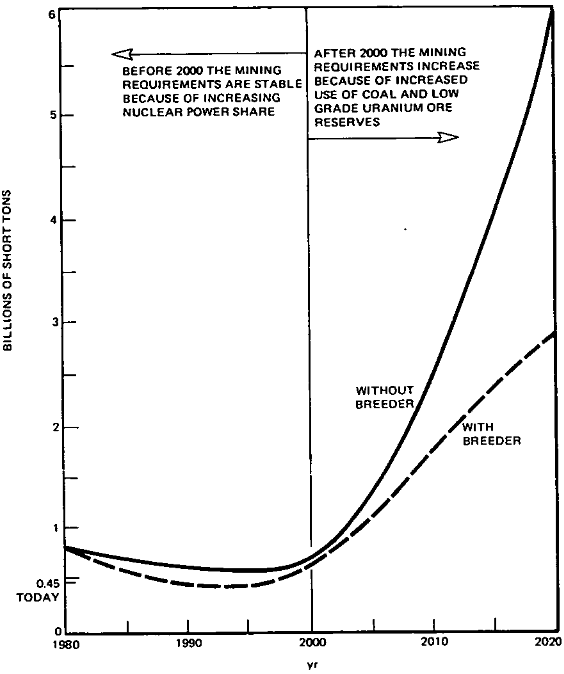

Figure 4. Combined Annual Coal and Uranium Ore Mined

other events could prove serious for the nation. For example, if it should turn out that the nation's recoverable high grade uranium resources are less than projected, and in addition the development of the breeder is delayed, the nation must greatly expand its use of two low grade energy resources, coal and uranium shales. The relative use that would be made of these two is certainly not clear now. However, if the choice were generally coal, the plutonium supply from light water reactors for new breeders would gradually decrease as LWR's are normally retired. In this circumstance, conversion to breeder reactors could then be accomplished only by fueling new breeders with high cost uranium.

5. Use of Advanced Converter Reactors

In the base case it is assumed that beginning in 1982 advanced converter reactors account for 25% of the nation's thermal reactor capacity. Other cases show that if converters account for only 10% of thermal reactor capacity, the present valued benefit of the breeder would be $94 billion (versus $76 billion in the base case). If the penetration of advanced converters should be 40%, the benefit of the breeder would be $59 billion.

In this analysis the characteristics of the advanced converter are optimized to minimize the use of uranium. The conversion ratio is about 0.9 and as a result, uranium consumption over a plant lifetime is two-thirds that used by a similar size LWR that is recycling plutonium.

For the base case advanced converter penetration (25%), the need to turn to uranium shales is delayed one year, from 2000 to 2001. This effect of the advanced converter can be seen by imagining all thermal reactors in the U.S. were advanced converters and that these converters would use uranium at two-thirds the rate of LWR's on recycle. In this scenario the extent of our uranium resources would effectively be increased by 50%, equivalent to only five years of uranium demand around the turn of the century.

6. Cost for New Uranium Enrichment Capacity

In the base case the cost of uranium enrichment is $70/SWU (75 $). This is consistent with various projections of expected prices for enrichment at gaseous diffusion facilities. It is recognized however that several new enrichment technologies are under development, the foremost of which are the gas centrifuge, and laser separation. The ultimate success of these cannot be forecast but the effect of enrichment costs being ultimately reduced 50% because of a new technology was investigated. Our analysis shows that to the nearest billion dollars, the benefit of the breeder is unchanged if the cost of enrichment should be one-half expected values.

There are several reasons why the effect of reduced enrichment costs on the need for the breeder is so small. The first can be understood by imagining a situation where enrichment is free and it is hence economically possible to take uranium tails to zero percent U-235. This would allow the nation to use the one-third of the uranium-235 that is presently discharged in the tails and in effect would increase the nation's usable U-235 by 50%. But this would defer the need to utilize uranium shales by only 5 years (from 2000 to 2005).

Perhaps more important, at present the LWR fuel cycle cost for enrichment is about three-fourths of the fuel cycle cost for uranium. By the year 2020, the cost of uranium will be such that it is likely the cost of enrichment will be closer to one-tenth the cost of uranium. It is for these reasons that new low cost enrichment processes cannot really affect the nation's need for the breeder.

7. **Coal Price**
One case was run to examine the effect if the price of new coal should be about 20% more than specified in the base case. The benefit of the breeder would be $86 billion for this situation. The conclusion is that within any expected range, the price of coal does not significantly affect the need for the breeder.

8. **Various Fuel Cycle and Reactor Performance Assumptions**
A number of analyses were performed to examine the sensitivity of the benefits of the breeder to the breeder's fuel cycle. In one case, it was arbitrarily assumed that breeder fuel fabrication and reprocessing costs would double. The benefit of the breeder is $60 billion for this situation (versus $76 billion in the base case).

If the breeding ratio of the commercial breeder should be 1.20 rather than the 1.25 as it is in the base case, the benefit of the breeder would be $65 billion; for a breeding ratio of 1.30, the benefit would be $89 billion.

If the specific power of the breeder is 1100 kW_t/kg-fissile rather than 900 as is specified for the oxide fuels assumed in the base case, the benefit of the breeder would be $100 billion. Either carbide or nitride fuels are expected to achieve specific power levels in excess of 1100. If the specific power would be 700 kW_t/kg-fissile, the benefit would be $41 billion.

CONCLUSIONS

Three results emerge with reasonable clarity from this analysis:

1. The intrinsic uncertainty in the ultimate domestic low cost uranium endowment is the most important single unresolved question which affects the economic benefits of breeder reactors. Given the present state of the art, it is not merely unknown, but also unknowable, whether the present uranium forecast, as used here, is too low — or too high. Nevertheless, the nation's endowment of high grade uranium must be many times presently projected resources to significantly reduce the need for the breeder.
2. The breeder could cost significantly more than a light water reactor without impairing its overall advantage. Its own lower fuel cycle costs, plus its contribution to lower costs for companion converter reactors, could offset a several-fold greater capital cost.
3. Successful introduction of advanced converter reactors — re-optimized versions of the HTGR's or the CANDU reactors — has no appreciable effect on the potential economic benefits from the breeder. These reactor systems may complement BWR's and PWR's, but they cannot supplant the need for breeder reactors.

The economic decision whether or not to develop a breeder thus evolves primarily upon our ability to guess nature's generosity in providing high grade uranium deposits and, secondarily, upon our ability to forecast the structure and growth in the national economy. The decision involves considerable risk, but the risk is asymmetric, because there are two sequential decision points. The first is the decision to develop the breeder, involving the commitment of some $5 to 10 billion in R&D resources. The second — the decision by the nation's utilities to construct multiple commercial plants, involving many hundreds of billions of dollars — is contingent upon the success of the R&D effort and also upon a demonstration of need.

The development cost of the breeder, therefore, may appropriately be regarded as an insurance premium paid to cover the nation against the possibility — or probability — that domestic low cost uranium deposits cannot be significantly extended. The maximum loss is $5 to 10 billion, which can be incurred if such extensive ore reserves are discovered that the breeder is unnecessary. Ideally, one would wish to quantify the probabilities of different levels of discovery — in order to give the decision-makers a better overview of the risks — but this is unfeasible for reasons that have been indicated.

Delays in developing a breeder capability can prove increasingly costly. We conclude that a two-pronged mini-max strategy provides the least-cost program for guaranteeing secure sources of electric power:

1. Sustain the R&D effort to develop the commercial breeder.
2. Accelerate the program to delineate domestic uranium resources.

By the mid 1980's, both programs can be close enough to fruition that the decision whether to proceed with commercial power from breeders — or to move on to solar or fusion power — can be reviewed once more but with better geological and technological foundations. This strategy appears to offer an optimal solution to the otherwise nearly intractable problem of choosing new energy technologies in the face of imponderable technical, geological, and economic uncertainties.

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MAY 8, 1975.

APPENDIX 2

EXCERPTS FROM BREEDER REACTOR ECONOMICS

(By T. R. Stauffer, Harvard University, R. S. Palmer, General Electric Company, and H. L. Wyckoff, Commonwealth Edison Company)

INTRODUCTION AND SUMMARY

The national economic benefits of the breeder reactor relative to light water reactors can be divided into two categories:

1. *Direct benefit.*—This equals the savings in lifetime fuel cycle costs that accrue because of the breeder's more efficient use of uranium (i.e. greatly reduced mining requirements) and the lack of need for fissle enrichment, less the effects of higher breeder capital costs. This is the direct financial savings realized by a utility which purchases an LMFBR rather than an LWR or fossil plant. It is this determination of the direct power costs of the breeder, relative to the light water reactor (LWR), as perceived by the utility, that will serve as a basis for the comparative cost data that is presented here.

There is a second benefit that while not included in the data provided here, should at least be mentioned.

2. *Indirect benefit.*—This is the reduced fuel costs that accrue to all LWR's because the introduction of breeder reactors slows—or eliminates—the steady increases in uranium costs due to the depletion of resources. Simulation studies, of which several have been published, reveal that the indirect benefits can be as large as the "direct benefits".

Both benefits are ultimately realized by the nation's consumers as lower rates for electricity, but the individual utility, in deciding between an LMFBR or competitor reactor, perceives only the direct benefit.

Here, we shall present only the cost estimates which a utility will use when choosing between a breeder and a converter reactor. These relate to the direct costs and benefits. The justifiable extra investment in a breeder increases with increasing uranium costs. If the "real" cost of U_3O_8 is $20.00/lb. over the reactor's lifetime, a utility would be justified in spending about one-third more in capital cost for a breeder than an LWR. The lifetime "real" cost of U_3O_8 is the levelized value of U_3O_8 that would result in the same total lifetime cost of U_3O_8 as the actual year by year costs when the year by year costs are in unescalated dollars. If the lifetime real cost of U_3O_8 is $60.00/lb., the breeder plant could cost about 85% more, while for the case of U_3O_8 at $100.00/lb., the breeder could cost about 2.5 times as much as an LWR.

The following table summarizes the allowable capital cost of the breeder over the LWR for three U_3O_8 cost levels.

ALLOWABLE CAPITAL COST OF BREEDER OVER LWR

Levelized U_3O_8 value of plant lifetime supply, excluding effects of inflation (per pound)	Allowable ratio of total plant costs (any year*) (breeder/LWR)	Projected year of occurrence
$20	1.34	1965–70
60	1.84	1985–90
100	2.35	2000–2005

*The reference case cost for an LWR is $400/kW(e) in 1975 dollars ($600/kW(e) for a plant installed in 1982).

It is projected that "lifetime" real costs of U_3O_8 will reach $60.00/lb. for reactors installed in 1985–1990, and $100.00/lb. after the turn of the century. The actual year in which uranium costs achieve any given levelized value is sensitive to the uranium supply curve (see below). However, the break-even uranium cost for which a utility will pay a given premium for a breeder reactor—for example, 34 percent more if U_3O_8 costs $20.00/lb.—is independent of any time pattern for uranium depletion or any assumption as to the size of the uranium resource base.

Thus, it appears possible that by the time the breeder is available, a utility could be justified in spending almost twice as much for a breeder as for an LWR. This spread will continue to increase during the years that follow the breeder's introduction, but the rate of increase and the final value of the cost premium depend upon the supply curve for uranium.

The calculations and assumptions are discussed in more detail later. It must be emphasized that the allowable extra investment cost is based upon a utility-type analysis focussed upon the decision to build single reactors. A national economic analysis, which includes the indirect benefits accruing to all utilities and consumers collectively, would indicate greater benefits and a higher justifiable investment/kw(e) for each uranium cost.

FUEL CYCLE COSTS FOR LWR AND BREEDER

The financial arithmetic that is applicable to the breeder and in fact all nuclear plants and their fuel cycles is neither unique nor unusual. Nevertheless, considerable care is necessary to ensure that the calculations are internally consistent, especially when using cost data based upon projected inflation rates. For example, a recently published analysis of the economics of the breeder treated plant and fuel costs as constant (which is economically equivalent to an assumption of zero inflation) but then used current carrying charge cost rates for capital, which embody a current rate of inflation. The results of such hybrid calculations are meaningless.

Our goal here is to preview the comparative economics of a breeder plant, versus an LWR plant on an internally-consistent basis, as viewed by an investor-owned utility faced with choosing between the two types of reactor. Table 1 shows the coordinated financial assumptions that are used in this analysis for investor-owned utilities. The cost of debt and equity, as well as the debt/equity ratio are based on the industry's past experience. Column (A) summarizes the "real" financial parameters, i.e. corrected for inflation and applicable to constant dollar capital outlays. Column (B) shows the comparable values for the case of a steady-state inflation rate of 6 percent.

TABLE I.—COORDINATED FINANCIAL ASSUMPTIONS FOR INVESTOR OWNED UTILITIES

	Percent	
	A	B
1. Rate of inflation	0	6
2. Cost of debt money for zero inflation	2.75	2.75
3. Cost of debt money with inflation (1×2), e.g., [(1.06×1.0275)—1]×(100)=8.92 percent	2.75	8.92
4. Cost of equity money for zero inflation	5.5	5.5
5. Cost of equity money with inflation (1×4), e.g. [(1.06×1.055)—1]×(100)=11.83 percent	5.50	11.83
6. Assumed debt/equity ratio for utility industry capitalization	55/45	55/45
7. Assumed Federal plus State tax as percent of total earnings [1]	50	50
8. Return on debt (cost for use of debt portion of money), (3×6); e.g. (0.55×8.92)=4.91 percent	1.52	4.91
9. (a) Return on equity (cost for use of equity portion of money), (5×6), e.g. (0.45×11.83 percent)=5.32 percent, and;	2.48	5.32
(b) Federal tax plus State tax (for 50 percent total tax on earnings) [1]	2.48	5.32
10. (a) Weighted-average interest rate (net of taxes), (8+9)	4.00	10.24
(b) Discount rate (8+9) for utility decisionmaking process (net of taxes)	4.00	10.24
11. Level annual revenue requirements excluding depreciation (effective interest rate plus taxes) (10a+9b)	6.48	15.56
12. Level annual revenue requirement with depreciation, 32-yr book-life and 16 yr tax life (determined by calculations using above assumption—not shown)	5.89	11.83
13. Charge for property tax plus plant insurance	.85	1.70
14. Level annual revenue requirements with depreciation, property tax and insurance (12×13)	6.74	13.53

[1] At 50 percent, assumed Federal plus State income tax is equal to return on equity.

Table II summarizes the key assumptions that have been made regarding the characteristics of the LWR and breeder. The breeder specification is conservative; the indicated fuel performance is achievable with oxide fuels without significant metallurgical development. Sufficient information is provided in Table II that analysts can make their own calculation based on their own assessments of any of the parameters.

TABLE II.—ASSUMPTIONS USED IN DETERMINATION OF "USE COSTS" FOR 1 FUEL CYCLE (REFERENCED TO YEAR OF PLANT STARTUP)

	Unit	Cost	Cost contribution—Mills/kwh(e)
LWR:			
U_3O_8 at 27,000 MWD/T	Dollar per pound	20	1.11
	Dollar per pound	60	3.33
	Dollar per pound	100	5.55
Enrichment	Dollar per SWU	50	.75
Fabrication (U-cycle)	Dollz per kg	60	.27
Fabrication (Pu-cycle)	Dollar per kg	155	.70
Reprocessing	Dollar per kg	35	.15
Overall plant efficiency	Percent	34	
Net Pu production (U-cycle)	gm/kwh(e)	2.45×10^{-5}	
Net Pu credit (U-cycle)	mills/kwh(e)/dollar/gm	2.45×10^{-2}	
Reload core inventory (Pu-cycle)	kg(Pu fissile)	3,500	
Discharge core inventory (Pu-cycle)	kg(Pu fissile)	1,800	
Net Pu consumption (Pu-cycle)	gm/kwh(e)	6.09×10^{-5}	
Net Pu cost (Pu-cycle)	mills/kwh(e)/dollar/gm	6.09×10^{-2}	
Breeder:			
Fabrication	Dollar per kg/(core)	500	.53
Reprocessing	Dollar per kg/(core+blanket)	120	.38
Overall plant efficiency	Percent	38	
Breeding ratio (at equilibrium)		1.25	
Compound system doubling time	Years	18	
Specific power (at equilibrium)	kwt/kg (fissile)	900	
Initial core inventory (Pu)	kg(fissile)	2,200	
Reload core inventory (Pu)	kg(fissile)	2,600	
Out-of-reactor inventory (Pu)	kg(fissile)	1,900	
Plutonium fabrication and recovery losses	Percent per cycle	2	
Net Pu production rate	gm/kwh(e)	2.39×10^{-5}	
Net Pu credit	mills/kwh(e)/dollar/gm	2.39×10^{-2}	
LWR and breeder:			
Plant rating	MW(e)	1,000	
Design capacity factor	Percent	80	

For the LWR, it is assumed: (1) That one fuel cycle lasts four years; (2) that U_3O_8 is purchased two years before reactor loading, and (3) that enrichment is purchased one year before loading. For the breeder, one fuel cycle lasts two years,and plutonium is purchased one year before reactor loading. For both the LWR and the breeder, fuel fabrication costs are incurred one year before reactor loading, and reprocessing is paid for and plutonium credit received one year after spent fuel is discharged.

The future costs of nuclear power and thus the need for a breeder reactor depend crucially upon what uranium will cost in the decades ahead. Figure 1 is a projection, based on ERDA and industry estimates of the nation's uranium resources of U_3O_8 market prices as a function of cumulative consumption. This projection is based on the effort that will be needed to recover the various grades of ore. It places the present market price of U_3O_8 at about $15/lb., and the price at the point of transition to the lower grade ores (shales) lies in the range of $65/lb. (75$). This estimated supply curve for uranium includes a large fraction of speculative resources whose existence is still unproven.

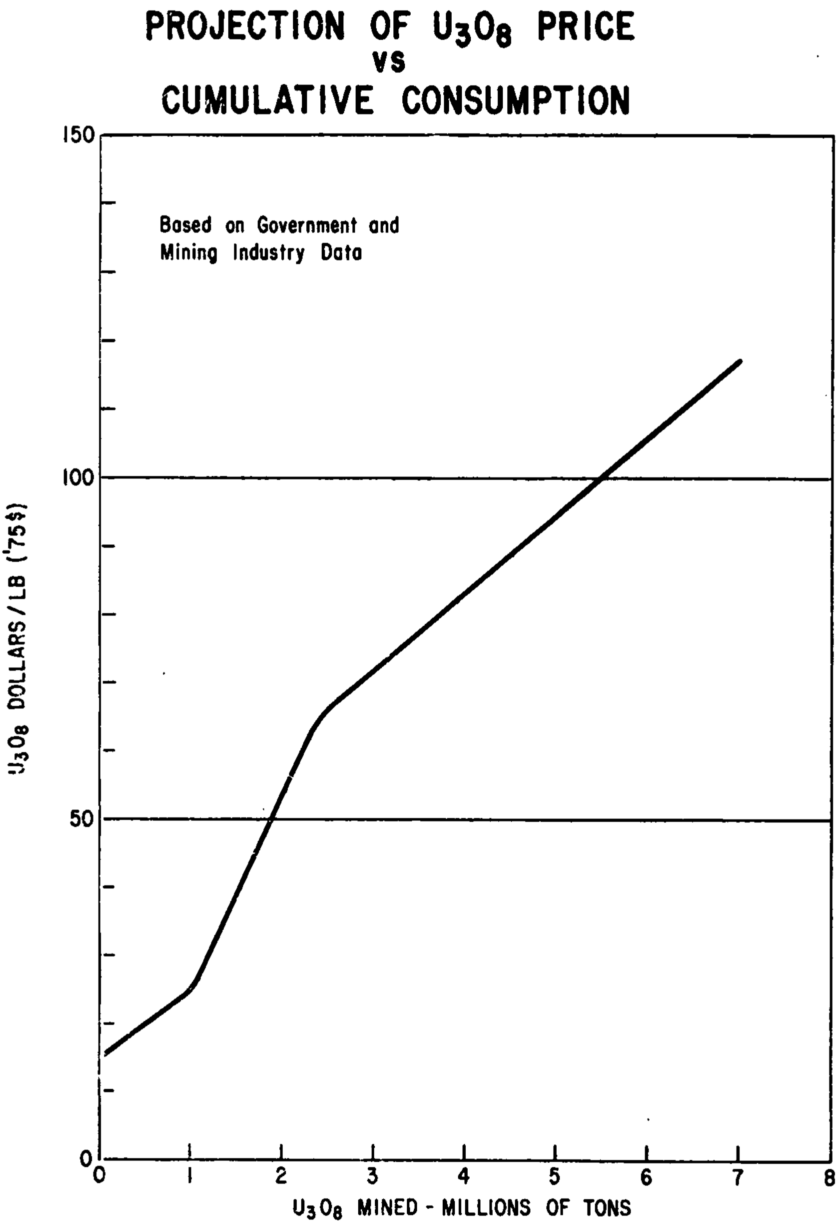

FIGURE 1

The lower curve on Figure 2 traces the cost of U_3O_8 over time as lower-cost reserves are consumed. Note that already in 1990, when the commercial breeder will first be available, the price of U_3O_8 is expected to be around $25/lb. (75$). Considering that offer prices for future delivery of U_3O_8 are already approaching this range, this projection may be unduly conservative.

The upper curve on Figure 2 is of particular significance; this is the present-value-weighted price of U_3O_8 faced by a reactor versus the year it comes on line. During the 30-year life of a nuclear plant, the cost of U_3O_8 will rise as one resorts to ever lower grade ores. This is quite apart from any effects of inflation, reflecting only the steady depletion of the better ores. The proper cost of U_3O_8 to use in evaluating the lifetime cost of power from the plant is the 30-year levelized "real" cost of U_3O_8. This is the equivalent constant cost of U_3O_8 over the lifetime of the plant which would result in the same total plant lifetime cost of power as the actual costs of U_3O_8 which increase steadily.

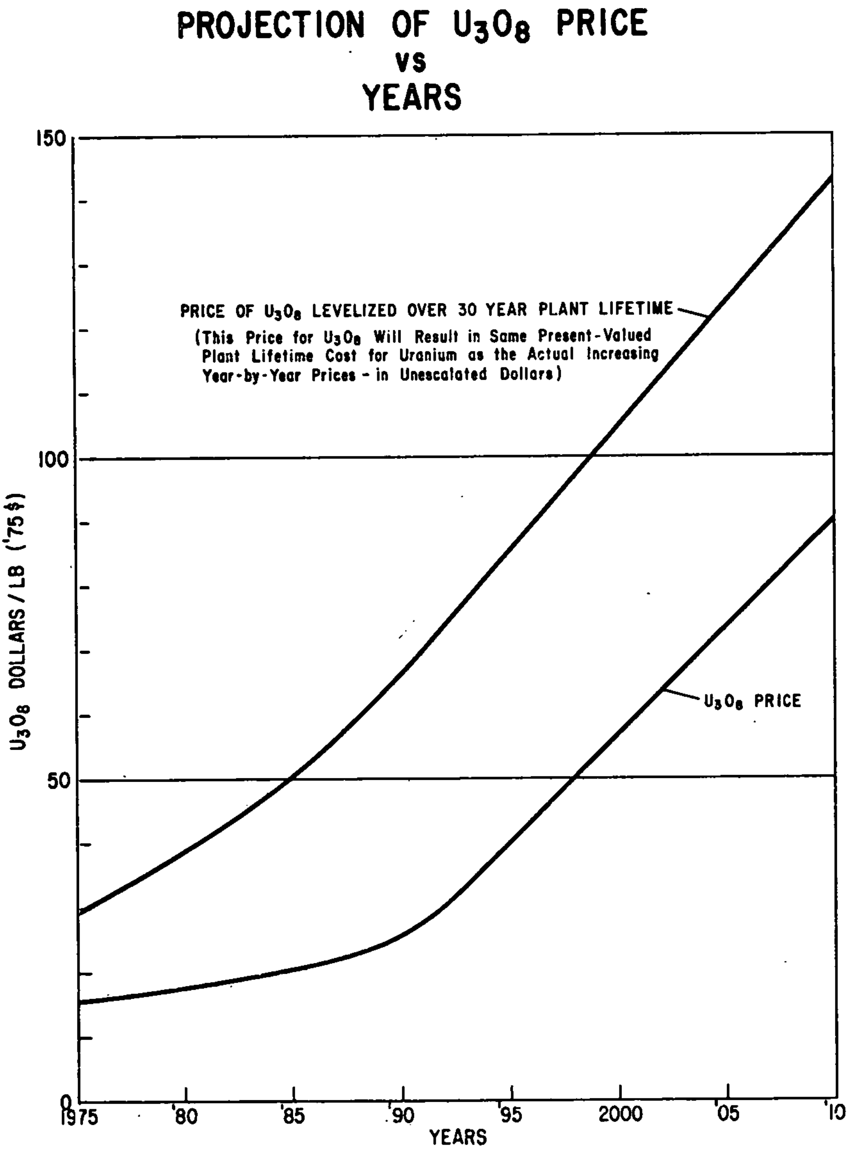

FIGURE 2

The upper curve on Figure 2 is a projection of the 30-year real costs of U_3O_8 for a plant which goes into operation in any year up to 2010. By 1990, the levelized cost of U_3O_8 is in the range of $60–70/lb. (75$), and by 2000 it is $100–110/lb. It is these costs of U_3O_8 against which the breeder will be competing unless major deposits of high grade uranium ore are discovered.

Tables III and IV are the final product of the analysis—the comparative fuel cycle costs for the breeder and the LWR, at both zero inflation and a 6 percent rate of inflation. These tables also indicate the additional capital cost that is justified for a breeder because of its fuel cycle cost advantage.

For a plant lifetime levelized "real" (not including inflation) U_3O_8 cost of $20/lb. Table III), the breeder lifetime levelized fuel cycle cost is 1.27 mills/kwh for zero inflation and 2.58 mills/kwh for 6 percent inflation. The comparable numbers for the LWR are 2.52 mills/kwh and 5.16 mills/kwh.

TABLE III.—FUEL CYCLE COSTS FOR LWR AND BREEDER (LEVELIZED OVER PLANT LIFETIME, U_3O_8 AT $20.00/POUND)[1]

[In mills per kWh(e)]

	Zero inflation	6 percent annual rate of inflation
LWR:		
Use costs:		
U_3O_8	1.11	1.64
Enrichment	.75	1.18
Fabrication	.27	.41
Reprocessing	.15	.33
Plutonium credit[2]	.38	–.90
Subtotal	1.90	2.66
Carrying charge costs:		
U_3O_8	.34	1.35
Enrichment	.18	.71
Fabrication	.06	.25
Reprocessing	.02	–.11
Plutonium	.06	.30
Subtotal	.62	2.50
Total	2.52	5.16
Breeder:		
Use costs:		
Fabrication	.53	.87
Reprocessing	.38	.79
Plutonium, net created[3]	–.38	–.82
Plutonium, plant constant lifetime inventory[4]		–.27
Subtotal	.53	.57
Carrying charge costs:		
Fabrication	.09	.37
Reprocessing	.03	–.17
Plutonium, net created	.03	.17
Pluntonium, plant constant lifetime inventory	.65	1.64
Subtotal	.74	2.01
Total	1.27	2.58
Allowable capital cost of breeder over LWR:[5]		
Fuel cycle cost differential	1.25	2.58
Equivalent capital cost (1975 dollars)[6]	[7] 129	[7] 134

[1] Assumed levelized value of lifetime uninflated costs of U_3O_8 (is measure of "real" costs).

[2] Assumed levelized value of lifetime uninflated costs (or sales) of plutonium. Zero inflation—Pu at $15.70/gm, 6 percent inflation—Pu at $16.42/gm. These values of plutonium result in same fuel cycle costs for LWR whether fueled with uranium or plutonium—Values of plutonium for zero inflation and 6 percent inflation are slightly different because of certain inflation related tax effects.

[3] Applicable only to net plutonium removed each cycle.

[4] Applicable to portion of plutonium (in core and out of core) that can be treated as a plant constant lifetime inventory. Since assets must be netted to zero at end of study, this inventory must be considered sold. For the zero inflation case, the sale exactl yoffsets the payoff of the original investment. For the inflation case, the final sale reflects 32-yr of inflation and is 6.45 times larger thad the payoff of the original investment. The "use cost" and "carrying charge cost" for the plant constant lifetime inventory of plutonium as treated here are economically consistent and the sum of the present values of the 2 is independent of the assumed rate of inflation.

[5] See table I, line 14 for carrying charge costs for capital.

[6] Compared to a capital cost of $400/kw(e) for an LWR starting up in 1975—Equivalent to $600/kw(e) for a 1982 startup.

[7] Kw(e).

TABLE IV.—FUEL CYCLE COSTS FOR LWR AND BREEDERS (LEVELIZED OVER PLANT LIFETIME, U_3O_8 AT $60.00/POUND)[1]

[In mills per kWh (e)]

	Zero inflation	6 percent annual rate of inflation
LWR:		
Use costs:		
U_3O_8	3.33	4.92
Enrichment	.75	1.18
Fabrication	.27	.41
Reprocessing	.15	.33
Plutonium credit[2]	.99	2.32
Subtotal	3.51	4.52
Carrying charge costs:		
U_3O_8	1.02	4.05
Enrichment	.81	.71
Fabrication	.06	.25
Reprocessing	—.02	—.11
Plutonium	.15	.78
Subtotal	1.39	5.68
Total	4.90	10.20
Breeder:		
Use costs:		
Fabrication	.53	.87
Reprocessing	.38	.79
Plutonium, net created[3]	—.97	—2.12
Plutonium plant constant lifetime inventory[4]		—.70
Subtotal	—.06	—1.16
Carrying charge costs:		
Fabrication	.09	.37
Reprocessing	03	—.17
Plutonium, net created	.90	.45
Plutonium, plant constant lifetime inventory	1.68	4.25
Subtotal	1.83	4.90
Total	1.77	3.74
Allowable capital cost of Breeder over LWR:[5]		
Fuel cycle cost differential	3.13	[7] 6.46
Equivalent capital cost (1975 dollars)[6]	[7] 325	335

[1] Assumed levelized value of lifetime uninflated costs of U_3O_8 (is measure of "real" costs).
Assumed levelized value of lifetime uninflated costs (or sales) of plutonium. Zero inflation—Pu at $40.53/gm, 6 percent inflation—Pu at $42.47/gm. These values of plutonium result in same fuel cycle costs for LWR whether fueled with uranium or plutonium—values of plutonium for 0 inflation and 6 percent inflation are slightly different because of certain inflation related tax effects.
[3] Applicable only to net plutonium removed each cycle.
[4] Applicable to portion of plutonium (incore and out of core) that can be treated as a plant constant lifetime inventory. Since assets must be netted to zero at end of study, this inventory must be considered sold. For the zero inflation case, the sale exactly offsets the payoff of the original investment. For the inflation case, the , final sale reflects 32 yr of inflation. and is 6.45 times larger than the payoff of the original investment. The "use cost" and "carrying charge cost" for the plant constant lifetime inventory of plutonium as treated here are economically consisent and the sum of the present values of the 2 is independent of the assumed rate of inflation.
[5] See table I, line 14 for carrying charge costs for capital.
[6] Compared to a capital cost of $400/kw(e) for an LWR starting up in 1975—equivalent to $600/kw(e) for a 1982 startup.
[7] Kw(e).

The magnitude of the fuel cycle costs for the 6 percent inflation case are larger than those for the zero inflation case for two reasons. First, with inflation, the carrying charge costs for capital are over twice as large (Table I, line 11) as for the zero inflation case. Of course, the present-values of the plant's total lifetime fuel costs are the same for both rates of inflation (and in fact any assumed rate of inflation when treated consistently as was done here).

We determine the extra capital cost which exactly offsets the lower fuel cycle cost of the breeder as follows. The levelized fuel cycle differential (6 percent inflation) is (5.16—2.58)=2.58 mills/kkwh (e). If the breeder operates at an 80% capacity factor, the annual fuel savings becomes:

$$\frac{2.58\times 8{,}760\times 0.8}{1{,}000}=\$18.08$$

Capitalized at a charge rate of 0.1353, \$18.08/year translates into a capital cost difference of \$18.08 divided by 0.1353 equals \$133.63, which rounds up to \$134/kw (e). An analogous computation, using the fuel cycle differential and the capital charge appropriate to the zero-inflation case, yields an allowance capital cost difference of \$129.

While the net fuel cycle cost advantage for the breeder is 1.25 mills/kwh (constant dollars) for zero inflation, and 2.58 mills/kwh (constant dollars) for a 6 percent inflation case, the resulting amounts by which the initial capital cost of the breeder can exceed the LWR and still remain competitive are essentially the same for both rates of inflation—\$129 versus \$134/kw(e).[1] This is because the assumed rate of inflation plays a role in determining the financial parameters, such as carrying charge cost and discount rate, that are used when converting actual plant and fuel costs to their equivalent mills/kwh.

Thus, except for the minor tax-induced discrepancy, the effects of inflation cancel in any comparison between plant and fuel costs and the real capital cost differences are the same for the zero and 6 percent-inflation cases, as one should expect.

As a point of reference, it is interesting to compare the LWR fuel cycle cost of 5.16 mills/kwh that is shown on Table III (for 6 percent inflation) with current industry statements that LWR fuel cycle costs are currently about 2.00 mills/kwh. The fuel cycle costs on Table III are based on U_3O_8 at \$20./lb., enrichment at \$50/SWU, and plutonium at \$16.42/gm. These assumptions reflect conservative projections of the expected cost picture within the next several years. The higher figures may be reconciled with the currently reported lower value. First, if the LWR fuel cycle cost of Table III is modified to reflect the recent past—U_3O_8 at \$10/lb., enrichment at \$35/SWU, and plutonium at \$10/gm—the levelized fuel cycle cost that reflects a plant lifetime of 6 percent inflation decreases from 5.16 mills/kwh to 3.33 mills/kwh. Second, if the fuel cycle cost is converted from the lifetime levelized value to the current cost (divide by 1.66) the present LWR fuel cycle cost is 2.01 mills/kwh. This is in agreement with the level of LWR fuel cycle costs the utility industry has been reporting.

The fuel cycle costs and the justifiable capital cost premium for the case of U_3O_8 at \$60/lb. are detailed in Table IV. For this cost of U_3O_8, a utility would be economically justified in selecting a breeder over an LWR even if its capital cost were as much as \$330/kwh(e) more than an LWR. Further calculations show that for a plant-lifetime levelized "real" U_3O_8 cost of \$100/lb., the capital cost differential between the breeder and the LWR could be about \$540/kw(e), i.e. a cost premium of 135 percent.

The allowable ratio of breeder plant capital costs to LWR plant capital costs is valid independently of the year of plant startup because: (1) the reference U_3O_8 costs exclude inflation (are in constant dollars referenced to the year of plant startup), (2) plant capital costs are inherently referenced to the year of plant startup, and (3) it is assumed that over the long run, inflation affects all cost components (plant and fuel) uniformly.

CONCLUSIONS

Five conclusions emerge from this close examination of the fuel cycle economics of the breeder and the LWR.

1. At today's market value of U_3O_8, a utility would be justified in investing about 35 percent more for a breeder than for an LWR, even if the real cost (75\$) of U_3O_8 might never increase.

2. At the time the breeder is commercially available—circa 1990—it appears probable a utility would find it economically attractive to select a breeder, even if its capital cost were more than twice that of an LWR. Moreover, this spread will continue to increase during the years that follow the breeder's commercial introduction.

3. Economic comparisons of nuclear alternatives for supplying electricity must be based on analyses that are internally consistent. An excellent method of checking the overall consistency of the economic technique being used is to make test analyses using several assumed rates of inflation. When the technique is correct, the results will be independent of the assumed rate of inflation.

4. These calculations understate the permissible "break-even" capital cost penalty for a breeder nuclear system, since a large part of the plant costs are for

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[1] The 4-percent discrepancy in the capital cost differential between the two cases arises because of certain inflation-related tax effects.

hardware and systems that are present in any nuclear plant, and not specific to the breeder plant. Thus, for example, a 35 percent premium justified for the breeder plant implies that the nuclear island might cost up to 70 percent more than the comparable part of an LWR plant.

5. The preceding analysis reflects the financial decision of a utility. The indirect benefits from breeders due to reduced long-term U_3O_8 prices for all reactors are not included herein, and the national economic cost-benefit calculus would suggest still larger cost premia for any given level of U_3O_8 costs.

Appendix 3

A Note on the Reliability of Mineral Resource Forecasts: The Precedent of Oil Reserves

"Excuse me, Mister Ranger. How many undiscovered Indian ruins are there left around here?"—Unidentified Tourist (Mesa Verde)

Any estimation of the amount of mineral resource which might ultimately be found in any given region is an exceedingly hazardous process. Even though it is vitally important for policy planners—both public or corporate—to have such estimates, whether for oil, gas, uranium, or other minerals, for rational planning, it is an unfortunate but unavoidable truth that such numbers are intrinsically elusive. A theoretically sound and reliable foundation for the forecasting of mineral resources simply does not yet exist, and past efforts have been notably unsuccessful.

Our recent experienec in estimating the potential oil resources of the United States provides a sobering insight into the dependability of such forecasting efforts. The abrupt revelation last year that our resources might be much less than expected highlighted the risks of basing oil policy upon speculative resources. The divergences and inconsistencies in estimates of oil reserves over the last 50 years illustrate the perils of policy planning based upon forecasts of mineral availability. A chronology of the better publicised estimates is recorded in Table One, where we note that total estimated oil resources rose steadily and reassuringly through the early 1960's.

In 1962, the Committee on Interior and Insular Affairs reported 407–507 billion barrels of recoverable resources and one year earlier, in 1961, A. D. Zapp of the U.S.G.S. had projected a yet higher figure of 590 billion barrels. These estimates promised domestic supplies for 60–100 years at 1962 levels of oil consumption, and the spectre of possible shortages was remote.

The then record high estimate of 590 billion barrels, as well as subsequent estimates from the U.S.G.S. were based upon one or another variants of what became known as the "Zapp hypothesis." This theory presumed that unexplored areas would be fully as productive as those areas which had been explored, and the total oil resources of the country, including the offshore areas, could be estimated by proportional extrapolation from known to unknown areas: "Estimates of ultimately recoverable reserves are based either on the assumption that the total volume of marine sedimentary rocks in the United States, or in the world, will yield petroleum and natural gas in amounts proportional to the yields obtained from the volume of rock thoroughly explored thus far, (or) on the assumption that the current observed trends in the ratio of exploratory drilling to the discovery of oil will continue into the future."

The premise is prima facie questionable, since the area extrapolation of oil resources assumes both that there is no geological selectivity to the habitat of oil, and also that the explorationist uses no a priori indicators as a basis for preferential drilling. The crucial assumption of homogeneity was increasingly challenged by empirical data on declining exploration yields in the late 1950's and early 1960's.

Subsequent estimates from different sources began to diverge increasingly and dramatically. A National Academy of Sciences report (upon which M. K. Hubbert collaborated) in 1962 forecast only 170–175 billion barrels of ultimately recoverable resources, less than one-third the value derived by the U.S.G.S. based upon the original version of the Zapp hypothesis. Three years later, the U.S.G.S. (Hendricks) scaled down its forecast to 400–450 billion barrels, having modified the Zapp method to include some allowance for decreased yield to new exploration outside of the initially most prolific geological provinces. In 1972, however, a still higher estimate emerged—more than 600 billion barrels, but explicitly including Alaska.

In 1974 the debate was joined, and several sets of irreconcilably conflicting estimates of potential undiscovered oil resources were released, just as the need for reliable estimates of U.S. oil potential had become acutely important, in the wake of the Middle East war of 1973 and the popular preoccupation with the "energy crisis". Hubbert released an estimate that only 72 billion barrels remained to be discovered, an amount barely equal to 10 years' requirements. The newest U.S.G.S. figure in 1974 was revised downwards, but still was 3–6 times as large as Hubbert's. An oil company estimate, purportedly based upon a detailed assessment of the hydrocarbon potential of each region within each geological province, yielded a still lower estimate than Hubbert's—only some 90 billion barrels.

Finally, a committee was convened by the National Resource Council to review the conflicting projections. It reported to the National Academy of Sciences that its own best estimates, weighing all evidence and alternative methodologies, was 113 billion barrels.

The COMRATE report, therefore, concluded that the maximum probable domestic resource base for petroleum barely sufficed for 20 years of consumption at 1974 levels. Moreover, this figure is an upper bound for the recoverable resources, because it includes some fraction which probably would never be discovered and another fraction which probably could never be developed.

This history has been summarized here—in the context of a discussion of future uranium supplies—in order to illustrate the possible risks in basing any part of our energy policy upon extrapolations of U.S. uranium resources. We simply do not know how much uranium is available in the U.S. at a cost below the break-even value which justifies development of breeder reactors. We do not even know whether current AEC estimates are high or low. But we should know that extrapolations of uranium supply—uncorroborated by actual drilling—have only tenuous geo-economical justifications. We also have seen the consequences of complacent reliance upon well-intentioned but unfunded prognostications of U.S. oil reserves, which promised ample potential resources yet to be found. These overly-sanguine forecasts disguised a pending shortage for almost twenty years, thereby forestalling the necessary prophylactic measures by at least as long.

It must be emphasized again that the greatest difficulty here is the uncertainty in resources forecasts. It is possible that the AEC's present estimates of 2-3 million tons may in fact be too high; some of the speculative resources included in that total may never be found or may not exist. Conversely, one might well find much more uranium, and Searl's otherwise unwarranted calculations might fortuitously prove to be correct. The central issue is the intrinsic uncertainty and therefore the need for the nation to hedge against predicating policies upon wrong guesses.

The experience with oil provides still another insight into the uncertainty. For some years forecasts of oil resources were in fact too low, as proven reserves caught up to earlier estimates of ultimate resources. The present "best estimate" of undiscovered resources is some 110 billion barrels; if this is added to known reserves plus cumulative production to date, the "best estimate" of total U.S. oil resources comes to 250 billion barrels of oil. Through 1956 the published estimates of our ultimate oil resources were still below that figure, exhibiting a downward bias and underestimating the "ultimate". Beginning with the Interior Department's estimate of 1956, followed by the several later and higher estimates based upon Zapp-type extrapolations, the estimates tended to be very high, contributing to an unwarranted sense of security. The moment of truth only came last year, and the phantom resources disappeared just when they were most needed.

At this point we do not know where we are along the comparable "maturity curve" for the domestic uranium industry—and we can learn only through the expenditure of time and money in accelerated exploration for uranium. The prospects for this exploratory effort are also uncertain. We cannot say with confidence whether the AEC estimates are high or low, and prudence dictates that we hedge our bets until such better knowledge is available. The fallibility of resource forecasts is so great that we must hedge any policy option which depends sensitively upon an estimate of uranium, oil, or many other mineral resources.

ESTIMATES OF U.S. OIL RESOURCES: A PARTIAL CHRONOLOGY

Date	Source	Recoverable resources (billions of barrels)
1908	Day (USGS)	10–23.
1915	Arnold (USGS)	12.
1918	Anonymous (USGS)	11.
1922	USGS/AAPG	15.
1931	Arnold & Kemnitzer	39.
1944	Pratt (Standard Oil of New Jersey)	100.
1948	Weeks (Standard Oil of New Jersey)	110 (land areas).
1952	Schultz (Standard Oil of Indiana)	170 (land) and 30 (cont. shelves).
1956	Pratt (Standard Oil of New Jersey)	145 (deGolyer & McNaughton 200B).
1956	Hubbert (USGS)	150–200.
1956	Department of Interior	300.
1961	Zapp	590B bbls (discovered and undiscovered).
1962	U.S. Senate, Committee of Interior and Insular Affairs.	407–507.
1962	National Academy of Sciences	170–175.
1962	USGS	885–1,000.[1]
1965	Hendricks (USGS)	400–450.
1972	USGS	608–3,000.[2]
1974	McKelvey (USGS)	200–400 (to be discovered).
1974	Hubbert	72 (to be discovered).
1974	do	213 (total discovered and undiscovered).
1974	Oil Co. "E"	90 (to be discovered).
1974	Comrate	113 (to be discovered).

[1] Inferred by Hubbert from a letter by McKelvey.
[2] Adapted by Hubbert.

Sources: "U.S. Energy Resources—A Review as of 1972," U.S. Senate, Committee on Interior and Insular Affairs, 93d Cong., 2d sess., serial 93–40, 1974. "Mineral Resources and the Environment," National Academy of Sciences, Washington, 1975.

Appendix 4

This note describes a very simple growth scenario which illustrates how electricity demand would grow at a rate significantly higher (plus 2–3 percentage points) than the GNP itself, even if the total end uses of energy would depart from historical behavior and grow somewhat slower than the GNP. Since the growth rate in electricity demand is the dominant variable which affects the long-term economic rationale for breeder reactors, this example—with its simple and explicit assumptions—can usefully clarify how electricity consumption can quite plausibly continue to grow more rapidly than the GNP, even through the early 20th century.

These calculations are in no sense a forecast; we assume hereafter that a target growth rate of 3 percent for the real GNP will be sustained—this is viewed as a social objective, recognizing but not accepting the argument advanced in some circles that growth is undesirable. However, one must recognize that most, if not all of the more formal forecasts of electricity demand, embody similar assumptions, albeit indirectly. The economic forecasts, as that of Messrs. Chapman, Tyrell, and Mount, thus are also implicit extrapolations of the past and contain rigid assumptions as to the structure of the economy.

Our illustrative "projection" deals with estimated end uses of energy in 2020, based upon looking forward from 1972 and presuming a compound growth rate of 3 percent in the GNP over that period. The final uses of energy in 1972 by major sector were:

[Quadrillions of Btu]

	1972 consumption	
	Total	Electricity (percent)
Households and commercial	18.2	3.5 (19)
Industrial	23.1	2.5 (11)
Transportation	18.1	[1].02
Total	59.5	6.0 (10.1)

[1] Negligible.

Electricity represented only 10 percent of final end uses of energy in 1972—a negligible one-tenth of one percent in the transportation sector but 19 percent of total household uses.

Looking forward, we postulate four effects:

1. population growth
2. growth in GNP per capita
3. substitution of electricity for other fuels, and
4. price-induced conservation

We observe that the cost of nuclear-generated electricity should rise less rapidly than fossil fuel costs. We subsume the substitution and conservation effects into the following assumptions about the penetration of electricity into existing applications of fossil fuels:

Sector	Penetration (percent)	End-use efficiency gain
Household/commercial	70	3.5
Industrial	40	1.5
Transportation	15	2.0

These values for penetrations and efficiency gains are plausible but of course are far from definitive. If penetrations are higher—as is likely in the household sector—or if efficiency gains are less than postulated, the calculated growth rate for electricity consumption should be still higher. For household and commercial uses, where space heating is the dominant use for fossil fuels, heat pumps offer an efficiency gain of 3–5, depending upon geographical region. Whereas a gas furnace transfers 60 percent of the energy in the fuel into the house, a heat pump can supply 180–210 percent of the heat equivalent of its electricity usage. For a broad class of industrial uses, electrical equipment promises increases in efficiencies from ca. 40–60 percent to 80–95 percent. The penetration factors and efficiency gains indicated here are derived from such considerations.

The resultant estimated final demands for all end uses of energy as well as electricity, are tabulated below:

[Quadrillions of Btu]

	End-use energy consumption (2020)	
	Total	Electricity (percent)
Households/commercial	44.7	26.5 (59)
Industrial	83.9	33.0 (39)
Transportation	58.2	7.5 (13)
Total	66.9	186.9(35.8)

In 2020 electricity would account for 36 percent of end uses of energy in this scenario, and the growth rate in electricity usage from 1972 to 2020 is 5.2 percent per annum, compared with a GNP growth rate of 3 perment (by assumption) and a growth rate in total energy of 2.4 percent. The sustained growth rate in electricity demand is twice that for total energy itself, reflecting substitutions induced by its favorable price in relation to fossil fuels.

Such substitutions have already commenced, and the pace may be accelerated as gas and oil prices in the U.S. rise to free market levels. This trend may accelerate if oil or gas become unavailable, as a consequence of price controls or political crises. Moratoria on natural gas attachments have already induced switching to electricity in the service areas of several Midwestern utilities.

This example, once again, is only illustrative, but it does indicate how substitution effects will play a central role in any forecast of electricity demand, over and above the basic forecast or target for economic growth. It thus offers insight into why electricity consumption growth will probably continue at a rate greater than that for the economy itself or all energy in toto.

BENEFIT OF BREEDER

METHOD

COMPARE ENERGY COSTS TO THE NATION WITH & WITHOUT THE BREEDER

GOVERNMENT DEVELOPMENT COSTS NOT INCLUDED

KEY ISSUES

BREEDER COSTS

URANIUM AVAILABILITY

GRAPH 1

BASE CASE RESULTS

$76 BILLION DISCOUNTED BENEFIT
($2.4 TRILLION UNDISCOUNTED IN '75 $)

BENEFITS OF BUILDING A BREEDER RATHER THAN A THERMAL REACTOR ARE TWOFOLD

DIRECT URANIUM SAVINGS

INDIRECTLY ALL THERMAL REACTORS PURCHASE URANIUM AT LOWER COSTS

COMBINED VOLUMES IN MINING OF COAL & URANIUM WILL INCREASE EXPONENTIALLY WITHOUT THE BREEDER

GRAPH 2

URANIUM RESOURCES	BENEFIT OF BREEDER TO NATION ('75 $ BILLIONS)
PROBABLE (BASE)	76
TWICE PROBABLE	44

GRAPH 3

CONVENTIONAL DEPOSITS

IN TONS U_3O_8

KNOWN RESERVES	700,000 TONS
ESTIMATED ADDITIONAL RESOURCES	1,700,000 "
TOTAL	2,400,000 TONS

GRAPH 4

URANIUM AVAILABILITY

CONVENTIONAL ORES

GRADE	—	.008 % TO 0.3 %
QUANTITY	—	2.4 MILLION TONS
PRICE	—	10 TO $65 / LB U_3O_8
LOCATION	—	WESTERN U.S.

SHALE

GRADE	—	.0025 % TO .0070 %
QUANTITY	—	13 MILLION TONS
PRICE	—	70 TO $200/LB U_3O_8
LOCATION	—	TENNESSEE VALLEY

GRAPH 5

BREAK-EVEN CAPITAL COSTS FOR THE LMFBR

LEVELIZED LIFETIME URANIUM PRICE	COST RATIO: LMFBR VS LWR
$20/LB.	1.34
60	1.84
100	2.35

GRAPH 6

ANNUAL ELECTRICAL GROWTH RATE		BENEFIT OF BREEDER TO NATION ('75 $ BILLIONS)
1975 to 2000 - 5 % 2001 to 2020 - 3.5 %		48
1975 to 2000 - 6 % 2001 to 2020 - 4 %	(BASE)	76
1975 to 2000 - 7 % 2001 to 2020 - 4.5 %		122

GRAPH 7

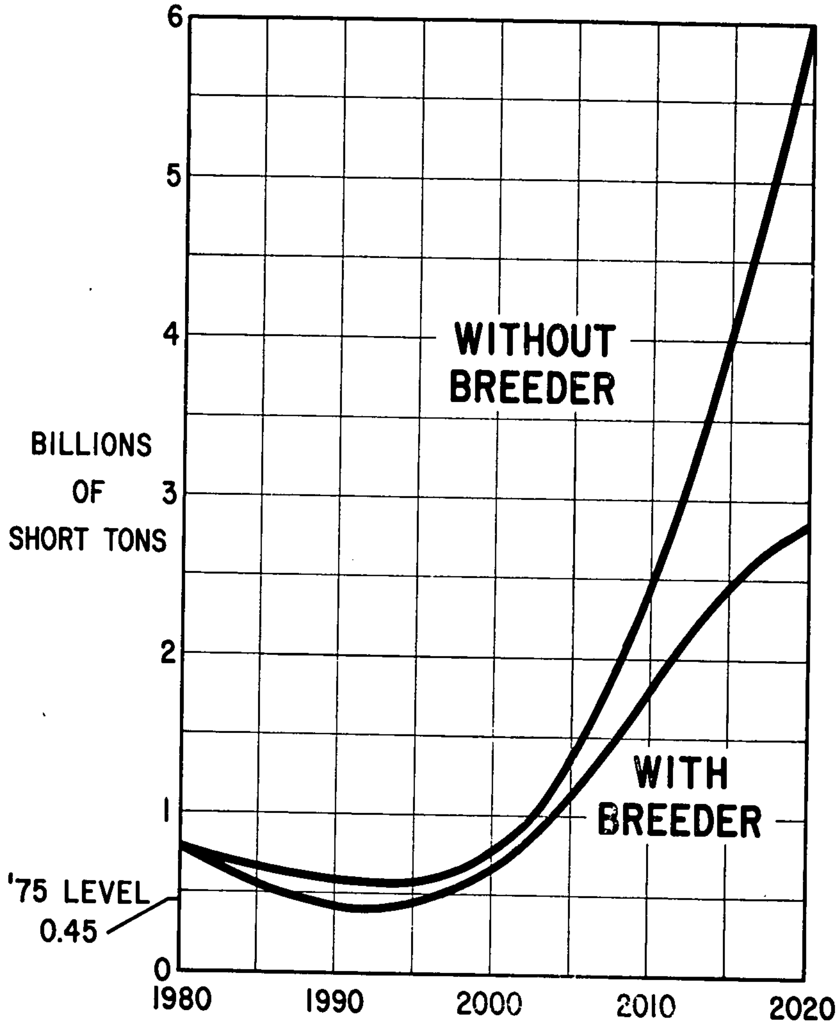
INTRODUCTION DATE OF COMMERCIAL BREEDER	BENEFIT OF BREEDER TO NATION ('75 $ BILLIONS)
1984	87
1989 (BASE)	76
1999	43
2009	19

GRAPH 8

CAPITAL COST OF BREEDER	BENEFIT OF BREEDER TO NATION ('75 $ BILLIONS)
1.25 LWR (BASE)	76
1.5 "	60
2.0 "	31

GRAPH 9

COMBINED ANNUAL COAL & URANIUM ORE MINED
(BASE CASE)



GRAPH 10

Mr. COCHRAN. I would like to make several comments on Mr. Stauffer's analysis. His analysis is driven primarily by three critical input assumptions. One is his assumption of the discount rate. He uses 6 percent, whereas OMB and EPA prefer a 10-percent discount rate. Had he used 10 percent his benefits of $76 billion would be reduced to about $20 billion, or somewhere in that range.

Furthermore, his net benefits would be even less because he hasn't subtracted the R. & D. costs.

Second, he uses a percent growth rate in electrical demand between 1975 and 2000 which is slightly higher than the AEC (now ERDA) assumptions which ERDA has now backed away from. He assumed 6 percent growth between 1975 and the year 2000.

Third, his uranium supply curve is even more pessimistic than the base case forecast assumed by the AEC.

As I mentioned before, we used a uranium supply curve that is consistent with the Eelectric Power Research Institute which is considerably more optimistic than the AEC supply figures.

Finally, he mentioned capital coest numbers and came back to that several times.

Last week Prof. Hans Bethe who has been consulting with Westinghouse Corp. said that by his estimates the breeder reactor would cost 50 percent more than the light-water reactor which is twice the figure that Mr. Stauffer uses in his base case. Furthermore, Bethe pointed out that the GAO has a breeder capital cost in their report which was 2.75 times the light water reactor cost. I think this figure is high because I think it includes first of a kind costs.

Mr. NADER. This is the testimony before the Udall committee, Mr. Chairman.

Chairman HUMPHREY. Yes.

Mr. COCHRAN. Mr. Stauffer's results aren't sensitive to certain things, for example whether or not we have the laser enrichment, but these assessments depend critically on what one considers as base case assumptions. If, for example, you are more optimistic about energy supplies and use a lower energy demand projection so that you are not depleting the lower cost uranium resources, then Mr. Stauffer's statements are no longer true.

I would also like to add with respect to his uranium assumptions, Mr. Stauffer mentioned 2.4 billion tons at less than $65 per lb. He got that by taking the AEC's resource estimate and simply doubled the cost estimate to account for certain items like profit. I think maybe going up 50 percent might be more reasonable, but again it all depends on your base. Mr. Stauffer is doubling from a base which is not realistic. Furthermore, in the ERDA uranium survey work currently underway, they have already identified another 1 million tons and their resource figure is now over a million tons. So there are a lot of things that need to be carefully examined.

Chairman HUMPHREY. Mr. Stauffer, you may reply to that.

Mr. STAUFFER. Just two points. I dont think ERDA has identified 11 million tons. Much of that is speculative. so it doesnt really add to our certainty at all.

With regard to the discount rate, this goes back to a point the chairman raised earlier; namely, benefits to whom? In the case of the breeder program, we are looking at a rather peculiar kind of project in that there are no monetary benefits to this at all. The benefits to this program result in reduced costs to consumers because one is looking at a breeder versus some other way of generating the same amount of electricity. So we don't have cash benefits in the usual sense, and this kind of analysis differs from the usual assessment of a Government project.

Here the benefits are reserved, they are in the form of a cost saving and given the way utilities have to work, they are governed by a rate base, if there is a cost saving in the operation they must follow that through to its customers. Here one is looking at the discount rate. One shouldn't be using the discount rate as an investment because the people who are receiving the savings are not corporations, they are the consumers. We don't go out and have investment opportunities to yield a 6 percent in real returns. The real return in the stock market for a 20-year period was under 5 percent. It is that kind of benefit we are talking about.

Chairman HUMPHREY. Mr. Nader.

Mr. NADER. Senator, by now you must be wondering how there can be such intense and conflicting viewpoints. In the breeder debate on nuclear power you have Nobel Prize winners on one side and the other. The inquiry goes a little deeper. Westinghouse Corp. obviously wants to sell more and more nuclear plants. There are consultants to a company that wants to sell more and more electricity irrespective of what the alternatives could contribute to a better society and better consumer value.

Let me describe this point in the conservation question. Whenever you see figures on conservation you see ranges, 10 percent, 20, 30, even 40 percent from a base. You say to yourself how can there be such ranges?

Senators and Representatives take these figures and they get very, very puzzled because they do not reduce these abstractions down to the basic emperical scrutiny from which these figures proceeded.

In that context, if we really want to see what the potential is for conservation, if we want to see whether a case can be made for a zero growth energy curve, we have to ask three questions: Do we really want it? As consumers I think we do, as Westinghouse and Commonwealth Edison, they don't, because that means reduced sales. Because zero growth means a more efficient use of energy for a given level of production and worker well-being.

If zero growth can be obtained by conservation along four lines, end use thrift, more efficient conduits of technology, more efficient production of the energy, and more effcient transmission of it, if this can be attained, then we had better focus on that as the first level of priority.

By that I mean the number of times people turn off lights, that is the end use, that is thrift. The kind of architectural standards for buildings and homes, that is the conduit technology. The kind of efficiency at the utility plant, including peak load savings, grid interconnection and the efficiency and net energy of the production sequence in getting the stuff out of the ground and down to the utility.

Let me give you an illustration. There are architects today who can demonstrate they can build a world trade center with less than 50 percent of the energy it now consumes without affecting other operations of that trade center except for lower bills.

The Los Angeles City government under the embargo stress decided to evoke a stress pattern on the production of electricity in Los Angles, one of the greatest waste areas in human history. A very modest program under that stress produced a 20-percent reduction in electric use. But in some of the buildings, like city hall, the reduction was much, much more dramatic and labor productivity went up.

Now, what we have to do is go to the main categories of users of electricity and ask ourselves what is the waste percentage, from the thrift, conduit, the transmission, and the production. I suggest we have to stop relying on Westinghouse and Commonwealth and Con Edison and make a survey of the use patterns throughout the country and speaking to the companies that have the vested interest in conservation because they are selling it.

A couple of weeks ago Honeywell had a two-page advertisement, "Cut Energy Costs by 25 Percent."

Chairman HUMPHREY. Du Pont has a division now?

Mr. NADER. Yes; they talk about a 15 percent per factory immediate cuts because they don't want to, you know, go out on the limb. But go to the smaller companies that are more bold and venturesome and check it out.

The overriding question here is how do you as a legislature evaluate competing claims and assertions. Some of them are based on numbers that can be traced back to their empirical deficiency, some of them are based on hidden perspective, and some of them are based on a refusal to follow through on the consequences.

On public television in Boston, a representative of Westinghouse was asked by one of the cross-examiners whether he would place Westinghouse's assets behind the assurances of such maximal safety as stated. He thought quickly and he—I think he said, "Yes." I wonder if Westinghouse would support that statement on that program.

It seems to me when an advocate makes an assertion on that, and does not back it up with the pocketbook, continues to support Price-Anderson and limited liability, that there is a question here of credibility. They want to reap the benefit but not assume the risk.

I think, above all, I wouldn't have suspected this of Mr. Simpson, the movement growing rapidly among nuclear power advocates to delethalize plutonium by verbiage, to deleathalize a massive carcinogen like plutonium.

There are different estimates. Mr. John Gofman, who is quite qualified, concludes that 1 pound of plutonium has a lung cancer effective potential in the range of between 9 and 25 billion cases. Some members of the industrial establishment say that is too much, it is only 1 billion cases, it is only 2 billion, it is only half a billion. That is also too much.

The process of delethalizing plutonium raises the question of whether there is such a thing as scientific reliability in the field when scientists are speaking for different constituencies, and unless Congress develops a framework of getting claim, counterclaim, claim and resolution, you are going to be continually flooded with the kind of thing that will cause you to throw up your hands to where the corporate power is.

I suggest that an energy source where the fate of one plant relies on the fate of the others is unreliable. The Government closed down 23 plants because a crack was found in one, Mr. Weinberg stated if there is one major nuclear catastrophe in this country, taking out a city, for example, one major melt down, that would be the end of the program. Not because the advocates will drop it, but because there will be such opposition by people who feel about their children and grandchildren and future generations and this land of ours which can be contaminated for decades, and let me make one prediction, if there is a major nuclear catastrophe in this country and this Nation relies on nuclear energy for electricity, you are going to see a modest civil war in this country between the people who want to abolish nuclear power and the people who think the economy will collapse. I don't want that kind of conflict or national security problem or governmental suppression of our civil liberties to safeguard mismanaged technological boondoggles.

Chairman HUMPHREY. I guess what you are saying in part, is that one of the alternatives we have is to pursue in a much larger and more intensive effort is solar energy; it has a great potentiality and should be pursued with massive efforts on our part.

Mr. NADER. It has occurred to you, I am sure, why solar has not been given such priority, solar, the Sun, has the nasty potential of going directly to your home, bypassing your friendly oil company and utility. Solar energy is the future source of energy on this Earth. The best thermonuclear reactor is the sun and it is well shielded.

Chairman HUMPHREY. I wish I had that testimony when I presented my bill. We did get it passed, the trick is now to get it funded.

Mr. NADER. And implemented by a government that is very cool on solar energy.

Chairman HUMPHREY. I want to assure all persons within range of my voice that we will be as relentless as Attila the Hun when it comes to getting it implemented.

Now, Mr. Simpson.

Mr. SIMPSON. It appears to me when Mr. Nader says he is for no growth in energy he is not taking into consideration the potentially disastrous effects of that. There is no evnironmental impact statement on no growth in energy. I am for people, I believe in people, I believe people should have jobs, I am for the underprivileged and the downtrodden, and it is an elitist philosophy when the self-appointed critics of the world take on themselves to criticize everybody else and in some devious way to try to make sure that the young people never have a chance for a decent standard of living, and that the people have to stay in ghettos and don't have the benefit of the things you and I enjoy every day.

Mr. Nader has had not one scintilla of evidence to back up most of the things he has said, and I ask the Chairman to please ask Mr. Nader to put supporting evidence in for everything he has said. He has quoted people out of context, he has misquoted people, he has a plethora of wild statements, but not one scintilla of evidence.

Mr. NADER. I consider that a personal affront. Since when is Westinghouse so concerned about the poor, the ghettos, and the workers of this country?

Chairman HUMPHREY. I suggest we keep this less personal and more factual and on the issues. I think the only reference Mr. Nader made that was personal was in reference to the delethalizing of plutonium. Make your response.

Mr. SIMPSON. That is not correct. The man he was talking about on the program in Boston was me. He was talking about Westinghouse Electric Corp. that I represent as an individual and it is indivisible from me. We have done our best as a corporate citizen to safeguard, we believe in safeguarding, we believe there should be no stone unturned to save energy. The most gross miscalculation we could possibly make would be to work on an energy source that was not going to be successful and was going to be turned down. That would, in truth, wreck the corporation.

Furthermore, we are working on solar energy. We do believe in solar energy, and it may bypass the friendly utility, but it won't bypass the manufacturer of the equipment. We have as much to gain in making solar energy as anything else.

I would again ask the Senator to have Mr. Nader back up his statement with information as to the source of any statements he made, and I would be willing to do likewise on any statement that I made.

Chairman HUMPHREY. May I make this suggestion. I knew this would be provocative and that is what it ought to be. I am tired of having congressional hearings in which we have mutual love affairs. I think we need to open up this whole business and let the American people know we have differences of view here, and as people have said here, there are Nobel Peace Prize winners on both sides of the issues here. I think we should keep those differences, however, upon the issues that are involved, the issue of safety, the issue of the possibilities of a nuclear accident, the issue of the costs, and benefits; also the issue, may I say, of the needs of energy for our economy. They are matters of great concern.

Now, Mr. Nader, Mr. Simpson has said that you should back up that zero energy proposition of yours with some more documentation. We don't have time today. I will welcome any statement you want to make and place it in the record.

Mr. NADER. Yes, Mr. Chairman; I will not take up your time in responding to these scurrilous characterizations by Mr. Simpson, but I do want to say that the man who made that statement on the Advocates program, whom I did not know, was Mr. Simpson, he made that statement. He wasn't speaking for the board of directors, which did not back him up, that he would pledge the assets of the Westinghouse Corp., behind the assurances of the nuclear power program that Westinghouse was promoting. That ought to be made a part of the record and not left open to question.

Chairman HUMPHREY. Well, may I express my appreciation for the quality of the testimony that has been given us today, for the vigor with which it was presented, and the sense of debate with which this exercise was manifested. I want to ask each of you to please supplement any testimony here today that you would like and any form of rebuttal that you might want to make so that it can be made a part of the record. We will hold the record open and if any of you feel you have not been treated properly by the chairman or by his committee, you should write to me personally and it will be made a matter of congressional record. One thing I try to do is preserve a balance so that we can give everybody a chance to be heard.

I have a feeling that we should have a repeat performance on this because you men are so qualified in your respective areas that the public needs to hear more from you.

Thank you, gentlemen, for coming.

Mr. NADER. Thank you, Mr. Chairman.

Mr. SIMPSON. Yes; thank you.

Chairman HUMPHREY. The hearing is adjourned.

[Whereupon, at 1:40 p.m., the committee adjourned, subject to the call of the Chair.]

[The following information was subsequently supplied for the record in the context of today's hearing:]

WASHINGTON, D.C., *June 26, 1975.*

Senator HUBERT HUMPHREY,
Chairman, Joint Economic Committee,
U.S. Senate, Washington, D.C.

DEAR SENATOR HUMPHREY: On May 8 I testified before the Joint Economic Committee concerning the plutonium breeder program. On the same day, in reaction to my testimony, a member of the House of Representatives made the following commentary on my testimony on the House floor (Congressional Record H 3852–3).

"Today, in the Joint Economic Committee, chaired by the gentleman from Missouri (Mr. Bolling), and the Senator from Minnesota (Mr. Humphrey), Mr. Ralph Nader stated, according to the news wire and a member of the committee who were (sic) present that—

" 'The reactor could experience an accident known as the "core disruptive accident." In everyday language, this technical euphemism means that the breeder can blow up.'

"Mr. Speaker, this is categorically untrue, and Mr. Nader knows it is categorically untrue. He knew it when he said it. Unfortunately, however, Members are being deluged with this kind of nonsense as they attempt to deal with the important energy issues facing us.

* * * * * * *

"There are those who would sabotage our nuclear energy program by spreading false stories about its safety, and try to frighten Congress and the American people into an irrational state so that the nuclear program will be weakened or abandoned."

In fact, the statement by the Member of the House is incorrect. He omitted the adjective "breeder" from my statement, thus making it apply to all reactors, not to "breeder" reactors, as I had quite specifically stated. I have never said that light water or other non-breeder reactors can explode.

Since the statement quoted was widely circulated through the Congressional Record and since the statement impugns the integrity of the statement that I have presented before the Joint Economic Committee, I request that the following brief materials relating to the explosive potential of the breeder reactor be placed in the hearing record.

Sincerely,

RALPH NADER.

Attachment.

THE EXPLOSION POTENTIAL OF THE PLUTONIUM BREEDER REACTOR

The following quotations provide a basis for beginning to understand the possibility of an explosion in a plutonium breeder reactor. The only conclusion that can be reached on the basis of the currently available information is that disruptive explosions can occur in fast breeder reactors. The exact nature and size of the explosion are matters of current debate among experts. Thus, those who would claim that explosions definitely cannot occur in fast breeders are either not telling the truth or are not apprised of the facts.

There are many issues—economic, safeguards, reliability, other serious safety questions. etc.—that argue against the breeder. In such an atmosphere of doubt, no decision about the future of the plutonium breeder reactor is possible. In the particular matter discussed above, the least that one can demand of the nuclear safety experts is that they absolutely guarantee the immunity of these reactors from such explosions. Such guarantees are obviously far from reality now.

There are two types of explosions possible in a breeder reactor. One category involves explosions caused by the reaction of sodium, a very hazardous material, with other substances in the reactor. The second category includes the small nuclear explosions which may occur under certain accident conditions in the reactor. Although these explosions are small, when compared to nuclear bombs, they may become a public hazard if they cause a break in the containment and radioactivity is released into the air.

CATEGORY ONE—SODIUM-RELATED NONNUCLEAR EXPLOSIONS

"The disassembly process has often been referred to as an 'explosion.' Technically, the term 'explosion' could be used in that one of the forces contributing to the disassembly can be fuel vapor. However, in virtually every instance, other earlier acting forces are available; for example, sodium flow, sodium vapor, and retained volatile materials, which would cause early disassembly. Only in the most conservative analyses does fuel vapor appear to be the driving force but, for conservatism, this is frequently assumed. Even for such 'explosions' the energies involved correspond to those of modest amounts, up to a few tens of pounds, of normal chemical explosives. It is absolutely impossible for any nuclear incident to lead to explosions of the magnitude associated with nuclear weapons, that is, many thousands of tons of explosive equivalent."

Proposed Final Environmental Statement, LMFBR Program, December 1974, p. 4.2–146. (ERDA Statement)

"There is clear disagreement in the method of calculation. There is clear disagreement in the criteria for acceptability of these doses. We have looked at a number of the scenarios and let me dwell on one for a moment. Quite a while ago, about three years ago. there was a HCDA scenario that had 150 megawatt seconds of energy release related to it. That energy release, with time, came down to a few tenths of megawatt seconds and the latest analysis gets it up in the range of 150 to 350 megawatt seconds. In all of these energetic analyses, from the 150 upward, there are leakage paths which are potentially opened and which put activity, noble gases, halogens, and fuel material into the containment. As long as the containment integrity is maintained such that we are at about a tenth of one percent leak rate, the doses off-site appear to be acceptable. But even in that event, there is on the order of 130,000 pounds of sodium splashed into the reactor cavity. Now we have a pool about four feet deep, or so, of hot sodium inside the reactor cavity, and there is a carbon steel liner with fire brick behind it called a hot liner. What the NRC staff has been concerned about in this situation even without melt-through, but with activity in the containment, is whether we are on the so-called edge of the cliff. If the liner fails, the sodium available in the pool will begin interacting with the concrete below it, under and behind the liner, and the degree to which you generate hydrogen depends on how big the failure in the liner is. It depends on whether the initial reaction leads to greater liner failure or not. In any event, if you proceed such that there is significant concrete and sodium interaction, there will be a significant amount of hydrogen generated, and we would calculate that they would be in a position of having to vent the containment in order to avoid explosive mixtures of hydrogen in the containment even without melt-through. What I said is that we got the activity up there, and we got something that is compromising or threatening to compromise the containment vessel integrity; and it is that scenario which is threatening the integrity of the containment so that we have asked them to look at it further. We are not satisfied with the numbers that they get."

Morgan, Karl Z., *Suggested Reduction of Permissible Exposure to Plutonium and Other Transuranium Elements*, submitted to Environmental Protection Agency Public Hearings on Plutonium and the Transuranium Elements, Washington, D.C., February 24, 1975.

CATEGORY TWO—SMALL NUCLEAR EXPLOSIONS

"Nuclear bursts: For both EBR–II (experimental breeder reactor) and Fermi (first demonstration breeder reactor), explosive energy releases from nuclear bursts as well as sodium-air reactions were considered as design basis accident ... The meltdown-reassembly ... accidents were calculated to produce energy releases roughly equivalent to the detonation of 300–500 pounds of TNT."

Atomic Energy Commission. Liquid Metal Fast Breeder Reactor Program Plan, Argonne National Laboratories, August 1968. p. 10–90, 10–92.

AN ESTIMATE OF THE ORDER OF MAGNITUDE OF THE EXPLOSION WHEN THE CORE OF A FAST REACTOR COLLAPSES

(Title of paper published by the United Kingdom Atomic Energy Agency). Reference: H. A. Bethe (Nobel Prize winner), J. H. Tait Report number UKAEA-RHM 56/113; 1956.

"No matter how it is phrased, "nuclear explosive energy," "Rapid reassembly of the fuel into a supercritical configuration and a destructive nuclear excursion," "rapid core meltdown followed by compaction into a supercritical mass," or, "compaction of the fuel into a more reactive configuration resulting in a disruptive energy release," the meaning is clear: LMFBRs are subject to "superprompt critical conditions," and, as the AEC well knows, this technical terminology translated into layman's language is an "atomic bomb." Thus, a more candid response to the Section 8-1 caption would be 'yes.' "

(Letter from George L. Weil to Robert Augustine reprinted at page 378, Nuclear Reactor Safety Hearings, Phase IIb and Phase III-Part 2: Vol. I. Joint Committee on Atomic Energy, 1974. Mr. Weil was a research associate of Enrico Fermi on the Manhattan Project. He was also Chief of the Reactor Branch, Division of Research; Chief of the Civilian Power Branch; and Assistant Director of Reactor Development Division of the Atomic Energy Commission.)

"In addition, the LMFBR itself is considered even less safe than today's light water reactors. The LMFBR core, where the heat is generated, is far more compact than a light water reactor core, and instead of water the LMFBR uses liquid sodium—an opaque and highly reactive element—as coolant. Partial loss of coolant—"voiding"—in a breeder increases the nuclear reaction in the core rather than reduces it. The LMFBR's operation is extremely sensitive to fuel motion and loss of coolant from the core in accident situations, leading to the possibility of an explosive nuclear runaway. In the event of a meltdown, the breeder's highly enriched fuel can rearrange itself into a more compact configuration with the possibility of small nuclear explosions of sufficient force to breach the reactor containment. There are major uncertainties in defining the explosive potential of the breeder, which are all the more worrisome considering the several tons of plutonium in it."

Bypassing the Breeder, Natural Resources Defense Council, March, 1975, p. 6.

"Contrary to thermal reactors, the geometrical arrangement of the core of a fast reactor does not correspond to the most reactive configuration. The enrichment of the fuel in LMFBR's is high enough to provide a potential for large reactivity insertion rates from coherent motion of the fuel, e.g., collapse of the core. Thus, the operation of a fast reactor is extremely sensitive to fuel motion during an accident. It takes only a slight compaction (about 2 percent volume reduction of a core) to trigger an explosive nuclear runaway. Similarly, a slight expansion of the reactor core would have a strong shutdown effect on any accident in progress."

The Liquid Metal Fast Breeder Reactor, Thomas B. Cochran, p. 173.

JULY 25, 1975.

Hon. HUBERT HUMPHREY,
Chairman, Joint Economic Committee,
U.S. Senate, Washington, D.C.

DEAR SENATOR HUMPHREY: I wish to submit the enclosed material, concerning the plutonium breeder reactor, as supplementary testimony to my appearance before the Joint Economic Committee on May 8. John Simpson of Westinghouse Electric Corporation appeared before the Committee on the same day to endorse the plutonium breeder. Mr. Simpson made a number of statements which I do not believe should go unchallenged. The enclosed material therefore contains a commentary on many of Mr. Simpson's points. Mr. Simpson's comments are printed on the left side of the page and points of rebuttal on the right.

I should also note that Mr. Simpson's testimony was not backed up by any references. My enclosed comments contain documentation and quotations.

During my May 8 testimony, I offered to submit supplemental information on energy conservation. I will do so here. A recent study by the American Institute of Architects indicates that by the year 1990, conservation from energy-efficient buildings alone could save more energy than nuclear power could supply. ("A Nation Of Energy Efficient Buildings By 1990", p. 3 and "Energy And The Built

Environment: A Gap In Current Strategies", p. 14, Figure 13. Both publications by American Institute of Architects, Washington, D.C., 1975.)

I also wish to quote from a study recently released by the Lawrence Berkeley Laboratory:

"Energy costs average over 10% of the gross national product, so that any government program aimed at curbing the 1974–75 recession-inflation could well employ energy conservation, in order to squeeze unproductive energy dollars back into the non-energy part of the economy. Even before considering the question of how much energy to import, one must confront energy conservation today: inefficient energy use means inefficient (and costly) mis-functions in the American economy." ("Energy Conservation: Its Nature, Hidden Benefits And Hidden Barriers", Lee Schipper, Lawrence Berkeley Laboratory, and University of California, Berkeley, June 1, 1975, p. 67)

Mr. Schipper's study is thoroughly documented and contains over 100 additional references.

I request that the enclosed materials be placed in the hearing record, in order to allow the facts to be discussed in a reasoned debate on the plutonium breeder.

Sincerely,

RALPH NADER.

Attachment.

RESPONSE TO TESTIMONY OF JOHN W. SIMPSON, WESTINGHOUSE ELECTRIC CORP.

John Simpson stated:	*Response:*
Today you are holding hearings on a matter of vital concern not only to the United States but to the entire world. True, other nations are developing breeder reactors and some may say they are ahead of us. These other nations also appeared to be ahead on the converter reactors, yet today U.S. light water technology is used throughout the world.	Export of U.S. reactors throughout the world also exports targets for sabotage and the potential for nuclear weapons proliferation. U.S. nuclear technology contributes to reactors, operating or proposed, in sensitive areas such as South Korea, Argentina, Brazil, South Africa, and the Middle East.
Today our nation finds itself in a severe economic recession brought on in part by the energy crisis. Furthermore, I submit we can recover from this recession only if we take actions to guarantee the energy needed to restore the strength of our economy and maintain it in the future. I call your attention to the charts attached to copies of my prepared statement.	Today our nation finds itself in a severe economic recession brought on by gluttonous and wasteful energy consumption which has put the country at the mercy of the Exxon-OPEC cartel. The control of prices of domestic coal and oil by U.S. energy corporations in 1974 caused an increase in energy costs of $18.1 billion, which is greater than the $16.8 billion increase from imported oil.[1]
As shown in Chart 1, energy growth and GNP growth have historically exhibited a remarkable lockstep relationship. We cannot say that the availability of energy causes economic growth. But we can say with certainty that economic recovery and growth cannot occur unless adequate energy is available for processing and manufacture and the marketing, transportation and sale of goods, products, and services.	"Our adaptation to a less energy-intensive economy would not reduce employment; in fact, it would result in a slight increase in demand for labor." "Other Project-supported studies also support the conclusion that we can safely uncouple energy and economic growth rates." [2]
For example. Mr. Chairman. as you know, our agricultural economy is based largely on the availability of low cost and abundant energy. Today, 13 percent of our total national energy goes for the	"Other ways to decrease energy use are to encourage the development of smaller. less energy-intensive farms; to use farming methods . . . which add nitrogen to the soil and minimize the need

[1] Documentation provided by Gary DeLoss. Staff Attorney. Corporate Accountability Research Group. Available from 1832 M St., N.W., Washington, D.C. 20036.

[2] *A Time to Choose*, Energy Policy Project of the Ford Foundation, Ballinger Publishing Co., Cambridge, Mass., 1974, p. 136.

production of food—just to get it to the grocer's shelf. On the basis of expected global population growth, it is estimated that merely to maintain current per capita consumption will require a doubling of the world food production over the next generation. Even more energy will be needed in the future to improve the standard of living, and also, oil and gas will be needed as a base for fertilizer production.

Chart 2 indicates that, if we are to recover from our current depressed economic state, then we must have a higher than normal energy growth between now and 1980. The future trends depicted on this chart make allowance for elasticity in energy prices, for conservation efforts which will result in a 10 percent savings in energy use by the year 2000 and a 20 percent savings by the year 2020, and for decrease in the productivity improvement and labor force growth rate.

Chart 3 shows our base energy forecast through 1980. If we build all the nuclear plants and mine all the coal we can by 1980, economic recovery will take place only with sharply increased oil imports.

To provide our energy needs beyond 1980, the only reasonable alternative is a commitment at this time, before it is too late, to expand our nuclear capability as France, Spain, and Japan are doing; and to utilize more of our available coal resources.

As shown in Chart 4, by expanding the the use of nuclear energy and coal, we will move toward a greater portion of our total energy in the form of electricity, conserving remaining supplies of oil and gas for use where no substitutes exist—feedstocks for chemicals, plastics, drugs, fertilizers, and fuel for aircraft. By 1990, with accelerated coal and nuclear use, we can maintain economic growth and at the same time virtually eliminate oil imports.

As shown in Chart 5, coal and uranium used in light-water reactors constitute 95 percent of our conventional energy resources, but so far provide only 19 per cent of our needs. Obviously, they must provide the bulk of our future energy. But coal cannot do it alone.

Commercial nuclear power, in operation in this country for nearly 20 years,

for nitrogen fertilizers; and to use biological pest-control methods as substitutes for the intensive use of chemicals. . . . Diversity of this sort could be the starting point for the development of a sound, efficient agricultural system."[3] In addition, more discriminating use of pesticides and herbicides, rather than application by large machines and airplanes can save energy in large doses.

Common sense indicates that if we are to recover from our depressed economic condition, the country must cut its energy waste. "Another recent study by two University of California scientists suggests that [per capita] energy consumption in this country could be cut to 62 percent of 1968 levels without reductions in the availability of material goods and services."[4]

Chart 3 shows a decrease in energy demand from 1973 to 1975, at which point energy demand skyrockets at a growth rate greater than historical demand. Oil imports are projected to decrease until 1975, when they skyrocket along with increased demand.

To provide greater self-sufficiency in energy, our only reasonable alternative is to cut energy use to levels similar to those of West Germany, Sweden, France, Spain, and Japan: which on a per capita basis are less than one-half to one-third U.S. per capita energy consumption.

Chart 4 is an extension of Chart 3 to 1990. It can also be seen from Mr. Simpson's Chart 4 that if energy demand levels can be kept at the levels of 1975, the country can do without nuclear power and oil imports in 1990.

By 1990, with sensible conservation, we can maintain economic growth and at the same time virtually eliminate nuclear power and oil imports.

Commercial nuclear power, in operation in this country for nearly 20 years, still cannot operate without massive government subsidy, direct and indirect. Nuclear power plants produce 8 percent of the nation's electricity, when the plants aren't shutdown for routine maintenance or for malfunctions. The nuclear performance record, which includes the two-week shutdown

[3] "U.S. agriculture is growing trouble as well as crops", Wilson Clark, *Smithsonian*, p. 64.
[4] *Ramparts*, August 1974, p. 53.

now involves 53 power plants, producing almost 8 percent of the nation's electricity. The nuclear performance record has demonstrated that nuclear power is safe, dependable, environmentally attractive, and economical. A late 1974 survey by the Atomic Industrial Forum showed that light-water reactors are providing electricity 40 percent cheaper than fossil-fueled plants.

The economy of nuclear plants is reflected in the household utility bills of those consumers fortunate enough to be using electricity generated by such plants. For example, Northeast Utilities in Connecticut and Massachusetts would have had to pay an additional $140 million last year for fuel if it were not for the fact that one-third of Northeast's electric generation is nuclear. That's an average saving of $140 a year for a million nuclear customers.

How about the period beyond 1990 and extending into the next century? This brings me to the need for the breeder reactor, specifically the liquid metal fast breeder reactor which has top priority not only here in the United States but also in France, the United Kingdom, West Germany, Japan and the Soviet Union.

Uranium, the basic fuel for today's light-water reactors, is a finite natural resource. The Energy Research and Development Administration has fixed known high-grade reserves of uranium at 700,000 tons and unidentified, potential sources at 2.7 million tons. Our known reserves will be committed to fueling, for their lifetime, light-water reactors operating by the early 1980s' and even if we find the additional 2.7 million tons of uranium reserves, they would be committed to the lifetime fueling requirements for light-water reactors starting operation in the 1990s.

The liquid metal fast breeder reactor, which produces more fuel than it consumes, uses uranium 60 times more efficiently than present nuclear reactors. It will extend from decades to centuries the period during which our domestic uranium resources can provide econom-

of 23 reactors when there is a crack in one, demonstrates that the reliability of the entire industry is dependent upon the operation of any one plant. David Comey, using economic data generated by Commonwealth Edison, the most nuclear utility in the country, found that electricity from Comm Ed's coal plants is cheaper than from its nuclear plants.[5]

The Council on Economic Priorities in New York City analyzed a claim by Consolidated Edison that its nuclear plants saved its customers $95 million. The Council found that figure represented equivalent oil fuel costs only. When capital and operating costs of nuclear plants are subtracted, the savings are no greater than $10 million, and might be negative.[6] Nuclear utility economics do not account for all the costs to the taxpayer to support nuclear power.

There is a growing citizen opposition to nuclear power in France, the United Kingdom, West Germany and Japan. This opposition has grown in spite of the fact that those countries do not have the domestic resources or the potential for conservation which exist in the U.S.

"As mentioned earlier, one of the critical input assumptions is the domestic supply of uranium. A number of independent investigators . . . believe the AEC has been overly conservative in estimating the domestic supply of uranium. The Environmental Protection Agency in its review of the AEC analysis stated that, '. . . the uranium supply could be significantly greater than that projected for the [AEC's] base case.' "[7]

The liquid metal fast breeder reactor may be 60 times or more as dangerous as light-water reactors. The fuel for the breeder will be plutonium, one of the most toxic elements known to man. A few millionths of a gram of plutonium has caused cancer in laboratory ani-

[5] "Chasing down the Facts", David D. Comey, *Bulletin of the Atomic Scientists*, February 1975, p. 40–42.

[6] Memorandum from Charles Komanoff, Council on Economic Priorities, New York City to Nancy Matthews, Office of U.S. Representative Ottinger, February 28, 1975.

[7] Statement of Thomas B. Cochran, Natural Resources Defense Council, before the Joint Economic Committee, U.S. Congress, May 8, 1975, p. 11–12.

ical electricity, not only by using uranium more efficently but by permitting use of more costly uranium.

As shown in Chart 6, breeder reactors will gradually supplement light water and other non-breeder reactor electrical generation capacity. By the year 2000, breeder plants will contribute almost 20 per cent of nuclear generated electricity, and by 2020 this figure will have grown to almost 75 per cent. Instead of having to strip for low grade uranium shales or import uranium, the LMFBR will provide us electricity to help drive an electric economy with no additional uranium mining to meet its fuel requirements.

It is not suggested that nuclear development be undertaken at the exclusion of all other energy research. Every promising concept should be pursued. However, all alternative sources such as solar, geothermal, wind, tidal, ocean gradients, and hydro together might supply only a few per cent of our energy needs by the year 2000. Thus principal reliance must be on coal and nuclear, with the breeder needed to extend the nuclear option for centuries to come if necessary.

The liquid metal fast breeder reactor is not a new energy technology. Since 1951, six experimental or test liquid metal cooled breeder type reactors have operated in the U.S., and there have been larger power producing plants abroad. Construction of the fast flux test facility, to test our breeder fuels and materials, is about 40 percent complete. The next major step toward commercialization is the demonstration plant at Clinch River.

As a prerequisite for commercialization, every new high technology concept, whether solar, geothermal, fission, fusion, requires a demonstration plant to confirm performance characteristics—operability, reliability, and maintenance—with industrially provided equipment developed beyond experimental versions. Without a

mals. Plutonium is also the raw material of nuclear bombs. The coolant for the breeder will be sodium, a highly corrosive substance which can react explosively with air or water.

". . . economic analysis of the potential of the LMFBR indicates that, contrary to Atomic Energy Commission expectations, the new reactor cannot be commercially competitive with existing energy sources until after the year 2010." [8]

"Recent estimates of the potential contribution of solar. geothermal . . . together with energy conservation measures indicate that these sources a one can more than account for the energy expected from the LMFBR in the year 2020, when the reactor is expected to have maximum input. Indeed, they can account for the energy expected from all fission reactors at that time." [8] For Fiscal Year 1976, the amount of money dedicated to the breeder program was more than the combined allocations to fossil energy development, solar energy development, geothermal energy development, advanced energy research, and energy conservation.[9]

The experience with breeder reactors has not been encouraging, to say the least. The Fermi reactor, outside Detroit, suffered a fuel meltdown which was more severe than the plant's "maximum credible accident." The Experimental Breeder—I in Idaho suffered an extensive fuel meltdown accident. A Russian breeder is believed to have suffered a sodium-water explosion which destroyed one of its steam generators.

There are 30 homes already built, and some 200 being built around the U.S. which sustain themselves on solar and wind power, or a combination. Geothermal power plants exist in northern California, New Zealand and Italy. The demonstration units for these technologies already exist. To assume that the commercialization of

[8] *Bypassing the Breeder,* Natural Resources Defense Council, Washington, D.C., March 1975, p. 3.
[9] Ibid., p. 2.

breeder demonstration plant, industry and the financial community would lack the confidence required for commitments to commercialization.

It is planned that the Clinch River demonstration plant will achieve criticality by July 1982, followed by a five-year demonstration period as part of the TVA system.

A good deal has been said in public debate about the costs of the breeder program. Estimated costs of the Clinch River demonstration program, over a 15-year period from 1972 to 1987, include research and development, designing and construction of the plant, and fuel, operating, and maintenance costs for five years. Of the one billion dollar increase over the 1972 estimate, about 75 per cent is accounted for by increased allocations for contingencies ($150 million) and inflation increases ($600 million) that have hit every major program in this country. One example is the Alaskan pipeline whose cost estimate increased from $900 million in 1969 to nearly $6 billion in 1974—an increase of more than six times.

$10.6 billion is what the U.S. paid for less than five months worth of imported oil in 1974. This is the estimated cost of the entire breeder program which covers the period from 1950 through the end of this century. What are the benefits of that investment?

A recently completed "Assessment of Economic Incentives for the Liquid Metal Fast Breeder Reactor" done by experts of Harvard University, Commonwealth Edison Company and General Electric Company, predicts a net economic benefit of the breeder for plants built through 2020 of $76 billion in discounted present value. If the dollar benefits were not discounted, but inflation alone factored out, the benefit would be $2.4 trillion, in reduced costs to produce electricity. If the total breeder development costs of $10.6 billion are present-value discounted to 1975, they become about $6 billion. Thus, as shown in Chart 7, the projected economic bene-

such technologies will be comparable to the history of nuclear power is absurd. These technologies are simpler and less dangerous.

Pittsburgh Plate glass is already marketing solar collectors for homes and commercial buildings.

In the mid-1960s, the entire breeder program cost was estimated at $2 billion. Latest cost estimates are $10 billion, which may still be too low. The Fast Flux Test Facility was originally planned to cost $87 million, but the latest estimate is over $1 billion. The Sodium Pump Test Facility, when it was authorized in 1966 was estimated to cost $6.8 million. The total Pump Facility cost is now estimated to be $57.5 million.[10] A study by MIT and Harvard economists found that the cost trend for nuclear power plants is outdistancing costs of other high technology facilities such as coal plants and oil refineries.[11]

The Federal Power Commission estimated that the costs of developing all non-nuclear technologies, including coal gasification, solar (direct and indirect) and geothermal technologies, advanced steam cycles, magnetohydrodynamics, fossil fuel effluent controls, and energy storage systems would cost less than $8 billion.[12]

Several cost-benefit analyses of the breeder have been performed with varying conclusions. Each analysis depends critically upon the accuracy of assumptions regarding the choice of discount rate; the cost of breeder research and development; the capital cost difference between breeders and conventional reactors; the future demand for electricity; and the domestic supply of uranium. The critical input assumptions can be juggled to come up with widely varying costs and benefits.

"We believe that if the Congress undertakes a careful analysis of all the critical input assumptions it will come to share our conclusion that the LMFBR

[10] Statement of Thomas B. Cochran, op. cit., p. 3.
[11] "The Economics of Nuclear Power", Irvin C. Bupp et al., *Technology Review,* February 1975. p. 15–25.
[12] Federal Power Commission, Report of the Task Force on Energy Conversion Research to the Technical Advisory Committee on Research and Development, November 1973, Draft.

fits, in the form of reduced cost of electricity, are more than 12 times the cost.

will not be commercially competitive . . . until one or two decades after the turn of the century.[13]

There are considerations which go far beyond mere dollars and cents in computing the ratios of costs and benefits, however. It would be a tragic record in history if through shortsightedness at this time we condemned our nation to economic stagnation when, with the investment of the equivalent of a few months of imported oil costs, we could assure future generations of a virtually unlimited supply of economical energy.

It would be a tragic record if the country embraced the breeder, with the dangers of a plutonium economy, when an investment smaller than that necessary for the breeder could develop the enormous potentials of solar or geothermal energy and allow the breeder to be rendered unnecessary.

Under normal operation the breeder will actually have less impact on the environment than any other technically proven power generating device. It will have less radioactivity release; much less air pollutant emissions—actually zero; less thermal, transportation, and land use impact.

Unfortunately, as the scientists considered waste disposal or management a non-problem, they did not communicate their thoughts very well to the public. These waste products will be relatively small in quantity and can be stored safely for thousands of years in geologically stable areas at an acceptable cost. Even less expensive storage methods may be developed or the long-lived components—the actinides—might even be recycled in reactors or other high level neutron sources and changed to shorter half-life isotopes. These are being worked on and safe engineered storage methods are available for the interim period if desired.

Current beneficial uses of radioactive waste derivatives include medical applications such as long-lived cardiac pacemakers and artificial hearts. They have been used in remote power sources, both in space and under the oceans. And applications are under development for use as low grade heat sources.

Reactors don't operate "normally". They break down frequently, but maintenance and replacement power costs are passed on to consumers. There are leaks, spills, unplanned radioactive releases, worker overexposures, and problems of human fallibility throughout the entire nuclear fuel cycle.

Members of the nuclear establishment admit privately that the waste problem is perhaps the most serious one they have to solve. A disturbing aspect of the waste problem is that solutions—solidification, recycling actinides, and permanent storage—are in the future but are mentioned as though they were present realities. The history of waste handling includes leaking tanks, human error, and the fiasco at the Lyons, Kansas site. Proper guardianship of nuclear waste requires guaranteed stability of human institutions and geological formations for periods that cannot realistically be guaranteed.

The nuclear establishment wishes to foist upon the public nuclear gadgets such as the plutonium pacemaker, which can be replaced at less danger by equally long-lived nonnuclear pacers. An independent panel of medical and lay experts recommended against the development of the nuclear powered artificial heart, although there were no nonnuclear alternatives.[14]

The liquid metal breeder reactor has several inherent safety features. Sodium coolant operates at near atmospheric pressure, which in turn reduces the potential for leaks. Guard vessels around components will prevent the system from draining, even if leaks do occur, and thus assure the ability to cool the core. Also, the breeder fuel has a unique

The liquid metal breeder reactor has several features which make it inherently more unsafe than water reactors. It is possible for the plutonium fuel to be rearranged such that it could undergo a nuclear explosion, which is not possible for water reactors. Loss of sodium from the breeder would tend to accelerate the chain reaction and lead

[13] Statement of Thomas B. Cochran, op. cit., p. 12.
[14] *The Totally Implantable Artificial Heart*, Artificial Heart Assessment Panel, National Heart and Lung Institute, DHEW Publication (NIH) 74–191, June 1973.

self-control capability which tends to automatically reduce any unanticipated increases in power level.

Because of the very excellent heat transfer properties of sodium and design of the coolant path, the breeder reactor will continue to be safely cooled by convection even if pumping power should be lost.

Sodium has been handled safely for many years in large quantities in commercial chemical processes as well as in laboratories and reactors in the U.S. and abroad. The technology for handling this liquid is well-known and LMFBR designs are such as to make it possible to assure the safe handling of the sodium. We have considered and taken action to prevent any reaction with water or air.

Another important point is a better understanding of plutonium toxicity. Plutonium is a dangerous material, but it is by no means the most toxic. Critics use the minimum quantity injected directly into the blood stream with a 50% chance of producing cancer. Here they use a value only about one-tenth of the correct one but, more importantly, using injection into the blood stream is absurd. With the probable methods of intake—inhalation or food ingestion—the dose would have to be 3 times larger for inhalation or 30,000 times larger for food ingestion. Many biological agents are far far worse. Plutonium in food is roughly hundreds of times less toxic than mycotoxins such as botulin, anthrax, and even some mushroom poisons.

Plutonium is less toxic than lead arsenate, selenium oxide, potassium cyanide and mercury dichloride. More significant yet, plutonium compounds are heavy, non-volatile, adhere to surfaces and are very difficult to disperse.

Estimates are that in any practical circumstance of plutonium released from a site, meteorolgy and buildings would reduce the effective dosage about 60,000 times, warning could give another factor of ten, and people could protect themselves by closing windows or even breathing through a handkerchief.

to a nuclear runaway, a situation which does not exist in present reactors.

Boiling of the sodium coolant would increase the nuclear reaction and in turn lead to more boiling, propagating an accident across the reactor core.

The Russian breeder demonstration plant experienced an explosion due to a sodium to water leak in a steam generator. Admiral Rickover abandoned plans for a sodium cooled reactor because of sodium leaks. Aides to the Admiral have stated privately that control of the sodium technology is the most difficult problem that Naval Reactors ever faced.

There is a campaign among nuclear power proponents to "delethalize" plutonium. The chief delethalizer, Bernard Cohen, states that plutonium is only 60 times as carcinogenic as benzopyrene, which itself happens to be a very powerful carcinogen. Dr. John Gofman, professor of Medical Physics at Berkeley, concludes that Dr Cohen underestimates plutonium's toxicity by 13,000 times.[15] The fact remains that inhalation of a few millionths of a gram of plutonium has caused cancer in laboratory animals. The fact remains that Glenn Seaborg, co-discoverer of plutonium, calls it "fiendishly toxic".[16] Botulin and other food toxins can be destroyed by heat. No one advocates these toxins as energy sources. Chemical poisons can be neutralized by chemical reactions. If you heat plutonium or cause it to undergo a chemical reaction, you still have radioactive plutonium that can be fashioned into weapons material.

"Air dispersal of a few grams of the type of plutonium now being produced in power reactors could kill most of the occupants of a large office building or enclosed industrial facility" [17] Dr. John Gofman calculates that plutonium from weapons testing has already committed 116,000 U.S. citizens to terminal lung cancer.[18] The cancer rate among work-

[15] "The Cancer Hazard From Inhaled Plutonium", Dr. John Gofman, to be published.

[16] *The Atomic Establishment*, H. Peter Metzger, Simon and Shuster, New York, 1972. p. 145.

[17] *To Establish A Department Of Energy And Natural Resources, Energy Research And Development Administration, And A Nuclear Safety And Licensing Commission*, Hearings, U.S. Congress. Senate Committee on Government Operations, February and March 1974, Testimony of Dr. Theodore Taylor, p. 107.

[18] "Estimated Production of Human Lung Cancer by Plutonium from World-Wide Fallout", Dr. John Gofman, July 10, 1975, CNR Reports 75–2.

In weapons testing, 5 million grams have been dispersed and no public health hazard has been found. No effect has been found in the millions of grams handled with some accidental exposures. Plutonium effects are confied to a relatively small geographic area.

Sabotage of nuclear plants that might cause serious public risks is far more difficult to achieve than critics claim. It would take a group, highly technically trained in both nuclear and sabotage, working undetected, hitting just the right places at the right time, with no measures taken to block them or warn the public. Thus, the relatively small consequences to the public and the great danger to themselves make this a most unlikely event.

There are only a few places in the fuel cycle where it makes any sense to divert the material for illicit reasons. There are technical alternatives available if needed, such as denaturing and closed fuel cycles which avoid shipment. Moreover, the present physical protection, guards, communications, etc. which are being constantly technically improved can give us adequate assurance of safeguarding the material.

If history proves us to be wrong in the projections discussed earlier, and if the U.S. proves to use less energy, rather than more, then the American people will enjoy an energy surplus, with lower prices than if there is a shortage.

But if history proves those who disagree with us to be wrong, and if it proves that the U.S. needs more energy—and if the necessary systems have not been developed to provide that energy, the United States' problem will be one not just of shortage, but of survival.

The risk of being wrong is just too great to take.

ers at the Rocky Flats plutonium factory is 7 times the average rate for the rest of Colorado.[19] A dock worker developing cancer from handling a leaking vat of plutonium.[20]

"Licensee and AEC officials agreed that a security system at a licensed nuclear powerplant could not prevent a takeover for sabotage by a small number—as few, perhaps as two or three—of armed individuals."[21] "Terrorist groups have increased their professional skills, intelligence networks, finances and levels of armaments throughout the world."[22]

"It seems to us that the present system of protecting facilities and transportation which handle special nuclear materials is inadequate."[23]

"No one knows from whose accounts the price of security would be paid, but we all know there would be no free lunch. The alternative to the occasional devastation of a city may be a garrison state."[24]

If industry is not successful in its efforts to create markets for continuing wasteful consumption, taxpayers and ratepayers will foot the bill for all the needless power plants that will have been built.

To be a viable energy alternative, nuclear fission must be a technology free from catastrophic failure. There can be no sabotage, no hijacking, no guerrilla activity. There must be stability in human nature, human institutions, and geological formations. Acts of God and natural disasters cannot be "tolerated".

The risk of being wrong is just too great to take. Systemic conservation and other energy alternatives are the economical and ethical courses for the future.

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19 "Dow Workers' Radiation Exposure Called High", Judith Brimberg, Denver Post, August 14, 1970.

20 "Radiation Standards for Hot Particles", Arthur R. Tamplin, Thomas B. Cochran, Natural Resources Defense Council, Washington, D.C., Appendix B.

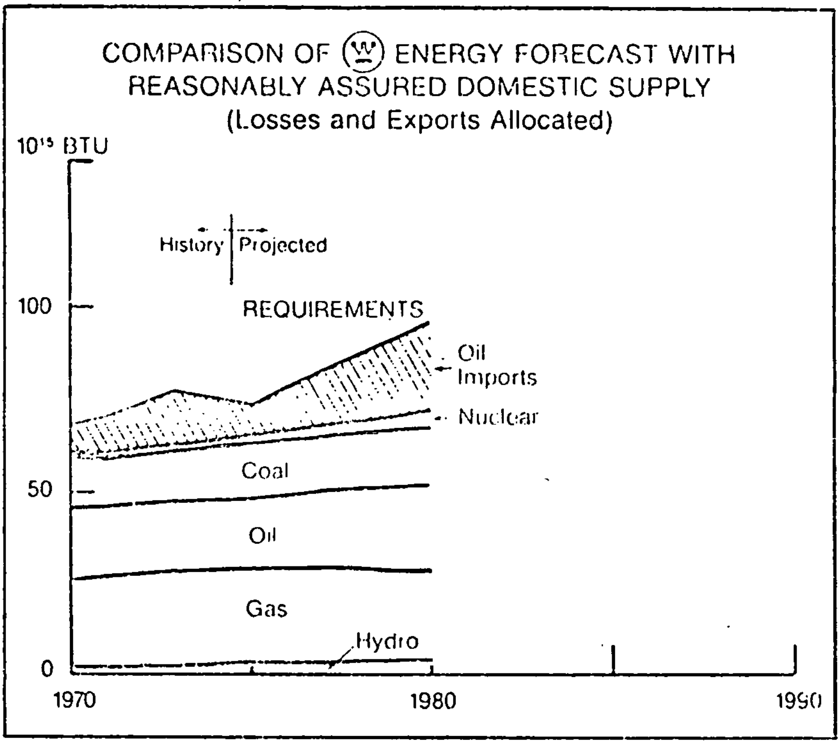
21 Letter from U.S. General Accounting Office to Dixie Lee Ray, Chairman, Atomic Energy Commission, October 16, 1974, p. 2.

22 Atomic Energy Commission Task Force Report on Safeguards, printed in the *Congressional Record* 120 ; S6623, April 30, 1974.

23 Ibid., S. 6624.

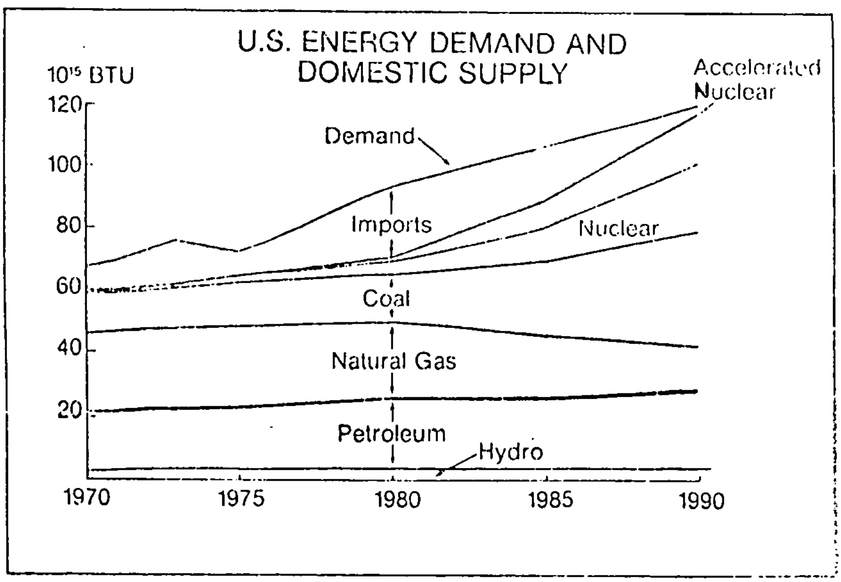
24 "The Dilemma of Fission Power", Donald P. Geesaman and Dean E. Abrahamson, *Bulletin of the Atomic Scientists,* November 1974, pp. 40–41.

EXHIBIT 3



Source: Testimony of John W. Simpson, May 8, 1975.

EXHIBIT 4



Source: Testimony of John W. Simpson, May 8, 1975.

COMMENTS ON THE
"STATEMENT OF RALPH NADER
ON THE
PLUTONIUM BREEDER REACTOR PROGRAM
BEFORE THE
JOINT ECONOMIC COMMITTEE
UNITED STATES CONGRESS
WASHINGTON, D.C.
MAY 8, 1975"

By the Westinghouse Electric Corporation
Advanced Reactors Division
P. O. Box 158
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INTRODUCTION

This document presents comments on statements made by Mr. Ralph Nader before the Joint Economic Committee of the United States Congress on May 8, 1975.

We believe that many of Mr. Nader's statements are incorrect, incomplete or unbalanced. Thus, we feel compelled to comment on the issues raised in Mr. Nader's Testimony, in such a way as to present a more complete set of facts so that those sincerely interested in understanding these issues, and establishing a personal position on this very important subject, are able to do so in a logical manner.

Comments are given on seventy specific statements, in the order in which they appeared in Mr. Nader's printed statement. The specific statements selected for comment cover many of the issues related to nuclear power in general, and the breeder reactor, which have been discussed by individuals or groups who are questioning the need for, and the wisdom of, proceeding with the nuclear electrical generation option.

We believe quite strongly that the option of economical electrical energy from nuclear fission is a necessary element of any future energy plan which has a high probability of sustaining a healthy domestic economy while minimizing our dependence on costly and unreliable oil imports. We also believe that the breeder reactor is a necessary element of the long-term nuclear electrical option.

CONTENTS

1. *"...the plutonium breeder reactor, like the SST was scheduled to become on a smaller scale, is a government-financed moloch, plagued by catastrophic dangers, massive cost overruns, and questionable economic value, which the government technocrats are building for the private utilities."*

   This opening statement which refers to the breeder as a "Moloch", a god who insists upon the sacrifice of small children, is irrelevant. The breeder, through its efficient utilization of our domestic uranium resources, will provide this country with the low cost electricity necessary to sustain a healthy economy and provide jobs in the future. It will provide the energy needed to sustain the American tradition of providing the less fortunate, rather than withdrawing from them, the potential for improving their standard of living through our free enterprise system.

2. *"During a time when increasing numbers of Americans are rejecting the risks of nuclear power or reluctantly accepting the risks..."*

   The basis for this statement concerning the "increasing numbers of Americans" rejecting nuclear power is questioned.

   The most recent information available to us indicates the following:

   (a) Responses to Senator Proxmire's questionnaire presented in his April 1975 report[1] indicate that his Wisconsin constituents overwhelmingly favor more reliance on atomic energy; 69.7% - Yes; 22.0% - No; 8.3% - Undecided.

   (b) Residents of Duxbury, Massachusetts, voted down a referendum that would have allowed delaying the construction of Boston Edison's Pilgrim 2 plant by 1,390 to 1,117. And residents of Searsport, Maine, voted overwhelmingly in favor of a nuclear plant proposal by Central Maine by a margin of 75% to 25%[2].

   (c) The results of a recent Roper poll showed that more members of the public favored a greatly increased program to develop atomic energy than opposed it. Moreover, the percentage favoring it was higher last fall than a year earlier. Roper reported that even though more people than not would like to see atomic energy vigorously developed, there is resistance when it gets right down to home.[3]

   (d) The results of polls reported in 1974, including the results of a survey in which residents of Los Angeles County favored construction of nuclear power plants by 71% to 29%, are mixed.[4]

On the basis of the information available, we believe that the people of this country are highly receptive to the nuclear power option, particularly in areas of the country where nuclear power provides a significant part of their electricity and has been responsible for substantial savings on their electric bills due to much lower fuel costs (see pages 13-17).

3. *"This step (the plutonium breeder), by taking crucial funds away from development of alternate sources, insures that our nation will have no option but nuclear power, whatever the risks."*

It is stated that the ERDA commitment to the breeder reactor is "taking crucial funds away from development of alternate sources." In fact, funding for development of alternate sources is increasing. Funding requests for all alternate energy sources for FY-76 are up significantly over FY-75.[5]

Fusion power R&D is up 41% to $120 million under ERDA. In addition, $54 million was requested for laser fusion development as part of the National Security Budget.

The ERDA budget request for solar sources for FY-76 is $57 million, up 655% over FY-75. The geothermal budget request of $38.4 million is up 280% over FY-75, and MHD and fuel cells R&D budget requests are $23.2 million, almost 200% more than the FY-75 figures.

In addition, the FY-76 request for conservation R&D is approximately double the FY-75 amount of $16.7 million.

Thus, there is no evidence that funds have been taken away from the development of alternate sources. All alternate energy sources should be developed as rapidly as possible, but increased funding is only part of the solution. The other ingredient for success is time. Fusion and solar power for economical baseload electrical generation will require major scientific, technological, and engineering breakthroughs or inventions. Money alone will not achieve this.

4. *"...nuclear power has not proved itself safe and reliable."*

Contrary to this assertion, the safety record of the nuclear industry is excellent. In all the years in which commercial nuclear power plants have been in operation, no member of the public has ever been killed or injured by any reactor-related accident or any radioactivity associated with reactor operation. This outstanding safety record supports the fact that no other technology or industry has ever been developed with as much attention to safety and environmental considerations. This record is a direct result of a dedicated and detailed engineering effort which focuses on nuclear safety.

Nuclear power is not only safe, it is reliable - at least as reliable as fossil power. In a December 1974 report, the Edison Electric Institute reported that 20 nuclear plants were available over nine months each year, somewhat more than comparably sized fossil unit availability. (Availability, the fraction of the time a plant could produce power in a given period, is a measure of reliability.) Accordingly, there is no basis for assertions of nuclear power unreliability.

This question is discussed further in comments and supporting references on pages 13-17.

5. *"For example, the 1973 internal Atomic Energy Commission (AEC) Task Force* report concluded that, reactor safety was an 'unanswered question.'"*

We have obtained from NRC a copy of a document entitled "Report Task Force for the Study of the Reactor Licensing Process," October, 1973 (Revision 1) and have been informed that this is the document that was furnished to the Commission for review. The title of this document, however, is not identical to the title of the document referenced by Mr. Nader. Accordingly, we checked with Mr. Nader's organization on June 11, 1975 and were advised by Mr. John Abbot that excerpts of the document referred to, the document he would furnish to us, are those set forth by Mr. Nader in Hearings Before the Joint Committee on Atomic Energy, Congress of the United States, Ninety-Third Congress, Second Session on the Status of Nuclear Reactor Safety, Part 2: Volume I, Phase IIb and Phase III Hearings, following p. 481.

We have compared the excerpts cited by Mr. Nader in the record of the JCAE hearings with the document furnished to us by NRC. We find that all of the excerpts are to be found in the document furnished by NRC, word for word, and on the very same pages cited by Mr. Nader. We conclude, therefore, that the document furnished by NRC is that cited by Mr. Nader, and note that it is not censored.

We have reviewed the document furnished to us by NRC and find that it does not contain the statement cited by Mr. Nader. This report was concerned with consideration of ways to change the licensing process.

*"Study of The Reactor Licensing Process: (uncensored draft) October 1973, Task Force Report to The Director of Regulation"

In this regard, it identified (on page 2) as guiding principles that ways and means to shorten the licensing process should be pursued, ways and means to make the process more efficient should be identified, and the entire problem of the current level of risk should be studied and recommendations made as to whether or not improvements in the level of risk are warranted or requried. These guiding principles were not cited among the excerpts included in the record of the JCAE Hearings, and therefore, the excerpts were somewhat misleading. In Section E, Level of Risk, the report stated on pp. 10-11:

> "Regulatory policies have continued to evolve, and have stressed the importance of assuring safe operations, but there is still an unanswered question as to the quantified degree of safety (or conversely the level of risk) of a nuclear power plant."

Mr. Nader placed this entire excerpt in the record of the JCAE Hearings (see Part 2: Volume I, p. 482).

It later noted that the Rasmussen Study would provide needed insight.

We believe, therefore, that the Task Force Report was improperly characterized and the excerpt which was placed in the record of the JCAE Hearings was quoted incompletely. We have discussed the report with a member of the Task Force. He does not recall that any draft contained a statement like that cited by Mr. Nader in his statement of May 8, 1975. The Task Force Reports published in December 1973 and January 1974 do not contain the statement cited by Mr. Nader. We would be interested in the views of the Task Force on this point today. We certainly do not agree that reactor safety is an unanswered question. We believe that the question has been answered in the affirmative - reactors are safe.

6. *"The adequacy of the Emergency Core Cooling System (ECCS) has never been demonstrated in full scale tests. The ECCS failed 6 out of 6 semi-scale tests at the Idaho test facility."*

A valid opinion on ECCS adequacy can be obtained by reviewing the substantial body of information submitted in compliance with 10 CFR 50.46 and Appendix K thereto, and the entire record of the ECCS hearing, taking into account the nature, relative importance, and weight of all of the evidence, which includes many test results and the qualifications of the witnesses. The logical place to look for such a well-reasoned opinion is in the concluding statement of the AEC Regulatory Staff at the ECCS hearing and in the December 28, 1973 opinion of the Atomic Energy Commission, which establishes new ECCS acceptance criteria for light-water reactors based upon the ECCS hearing record.

In its opinion establishing the new acceptance criteria, the AEC said:[6]

"As the massive record developed during this rulemaking shows, a wide spectrum of knowledgeable opinion exists concerning the adequacy of our current regulation on this subject--the Interim Acceptance Criteria--and with respect to the nature and scope of regulations which should be adopted at the present time. We have carefully considered the entire record and the many points of view it encompasses in reaching the decision we announce today. We believe that our decision affords the required reasonable assurance of protection for the public health and safety with a substantial margin."

In a separate concurring opinion, Commissioner Anders noted his general agreement that the record leads to the Commission's conclusions. He noted, [6] however, that:

"There are areas in which further research is necessary. In particular, the record shows conflicting estimates as to the acceptable maximum cladding temperature. Though I have accepted the recommendation for a limit of 2200°F (reflecting a conservative interpretation of the the available experimental data), I am inclined to believe that there is a high probability that this interpretation is overly conservative. But, the limitations of the present record do not justify any course other than that which we have taken today..."

Dr. Dixy Lee Ray, former Chairman of the USAEC, in her January 22, 1974 statement[7] to the Joint Committee on Atomic Energy of the Congress, said (relative to the AEC decision on the ECCS hearing):

"The unanimous opinion of the Commission is based on careful review of all pertinent issues, and it takes into account testimony and statements by all participants. It is not surprising that during the hearing there was disagreement on some of the technical questions among some experts, even including members of the Regulatory Staff, especially since these witnesses were expected to express their individual views."

In January 1974, the Joint Committee on Atomic Energy held nuclear reactor safety hearings and all critics of nuclear power were invited to appear. The most significant outcome was that scientists who testified in the ECCS hearing as having reservations about the Interim Acceptance Criteria testified before the Joint Committee that they agreed with the December 28, 1973 ECCS Opinion of the Commission, as evidenced by the following quotations from that testimony.

January 23, 1974 -- William B. Cottrell, [8] Director, Nuclear Safety Information Center, Oak Ridge National Laboratory:

"I would like to make clear, that to the extent I am qualified to judge, both the Regulatory Staff in the preparation of its Concluding Statement of April 16, 1973, and the Commission in remolding this Staff position to arrive at the criteria of December 28, 1973, have done their work thoroughly and well.

While I never believed that the risk associated with the Interim Acceptance Criteria of June 1971 was very great, I have no doubt that the approach taken in arriving at the new criteria and the new criteria itself, are fully compatible with my understanding of the desired degree of protection of the health and safety of the public, and how that may be attained."

January 23, 1974 -- Cyril B. Lawson, [8] Associate Director of the PWR-Blowdown Heat Transfer Program, Reactor Division of the Oak Ridge National Laboratory:

"I am fully satisfied that the Regulatory Staff and the Commissioners have responded appropriately, deliberately, and adequately in a manner that fully supports the Commission's policy of 'Defense in Depth' in matters that pertain to the protection of the public health and safety."

"I believe that the members of the Regulatory Staff who participated in the ECCS hearings have done their job well."

January 24, 1974 [9] -- L. J. Ybarrondo, Aerojet Nuclear Company, Consultant to the Advisory Committee on Reactor Safeguards (ACRS):

"The criteria should serve as an excellent guide to members of nuclear industry responsible for ECCS-type calculations. For the AEC, the criteria should provide a uniform method for 'measuring' the acceptability of emergency core cooling systems."

January 24, 1974 [9] -- J. O. Zane, Aerojet Nuclear Company, Consultant to the AEC Regulatory Staff:

"I have reviewed the opinion of the Commission covering the Acceptance Criteria for Emergency Core Cooling Systems for Light-Water-Cooled Nuclear Power Reactors. It is my view that the Commission has properly evaluated the technical discussions relating to the interim criteria and has developed an acceptable rule regarding this matter."

"The new rule is undoubtedly conservative, as it should be, in areas where the technical basis is minimal."

Thousands of tests have been conducted which provide information concerning the physical phenomena known to occur during a loss-of-coolant accident. Both the NRC and the nuclear industry, in vigorous applied research in the specialized field of loss-of-coolant accident emergency core cooling system technology, have performed numerous separate effects tests and integrated effects tests. Applied research in water reactor safety has included over 100 loss-of-coolant accident-related research programs comprising thousands of individual tests since the mid-1960s, with expenditures of several hundred million dollars. These tests, based on sound engineering practice, included full-size tests of components of the reactor and the emergency core cooling system, tests in full-size reactor fuel assemblies of fluid flow and of heat transfer by emergency cooling, scale model test of heat transfer by emergency cooling, scale model test of heat transfer during coolant depressurization, steam-liquid interaction during emergency cooling delivery, fuel clad swelling and oxidation, scale model tests of an entire reactor system from initiation of coolant depressurization until emergency cooling delivery, and scale model tests in a reactor of fuel element changes during nuclear heating combined with loss-of-coolant accident fluid conditions. Through these tests, the conservatism of design and analysis methods have been confirmed, assuring that designs based on these methods will work if they are ever needed.

The semi-scale tests that were mentioned by Mr. Nader were not intended to simulate the ECCS of a power reactor in any degree whatsoever. This was not the purpose of the tests. The purpose of the tests as stated by J. O. Zane, of Aerojet Nuclear Company, before the January 24, 1974 session of the JCAE, [9] was "to look at the mixing of cold water with the residual fluid as it was blowing down. It was not our intent nor did we even try to portray them [the semi-scale tests] as simulations of what would happen in a power reactor."

Nevertheless, as a consequence of these tests, the Commission issued the Interim Acceptance Criteria to conservatively account for the effects highlighted by these tests. Analysis of ECCS performance in accordance with these requirements, and subsequent analyses in accordance with the requirements of the new criteria resulting from the rulemaking, showed that the ECCS design is adequate.

It is on the basis of the entire record of the hearing, tests, analysis, and, indeed, of plant operation summarized briefly above, that we base our opinion that the ECCS has been tested and is adequate.

7. *"At least one expert within the Nuclear Regulatory Commission's Advisory Committee on Reactor Safeguards admits that, in spite of the AEC/Rasmussen Report, the adequacy of this key safety system has not been demonstrated. (The NRC, however, refuses to release the expert's name.)"*

The actual statement referred to here was made during the Executive Session of the ACRS's Regulatory Guides Subcommittee Meeting on June 5, 1974, in which proposed revisions to Regulatory Guide 1.7 were considered. As reported on page 2 in the minutes of this meeting,[10] the statement made was:

> "...He expressed concern that all of the margins incorporated into the ECCS acceptance criteria are being attacked and clipped away. He claimed that there is no real statistical basis for assuming that the ECCS is reliable, in spite of the Rasmussen study. He referred to a letter from ________, dated April 30, 1974 which describes several ways in which the failure of non-Class I systems or components can negate Class I systems..."

As a matter of policy, the ACRS does not disclose the identity of the statements in order to preserve the confidentiality of their deliberations. The statement, while claiming that there is no real statistical basis for ECCS reliability, did not question ECCS adequacy. (See pages 4-7 for a discussion of ECCS adequacy.)

The ACRS, in their Report on Water Reactor Safety Research dated November 20, 1974,[11] set forth their views on additional safety research oriented to LOCA-ECCS. In their report, Status of Generic Items Relating to Light-Water Reactors dated March 12, 1975,[12] the ACRS listed ECCS Capability of Current and Older Plants in Group IA-Generic Items Resolved Since December 18, 1972; it listed ECCS capability for Future Plants in Group II-Resolution Pending, noting that this matter is partially resolved.

While still of the belief that additional research should be done, the ACRS has continued to assert that individual plants can be constructed and operated. ACRS letters incorporate dissenting views of members when they have important concerns which they feel are not adequately resolved. They are published with the names of the members whose views are being expressed. No such concern has been expressed with regard to the adequacy of ECCS under the Commission's present rules.

8. *"Other AEC scientists have publicly stated their disbelief in AEC's assurances of ECCS reliability."*

Westinghouse contacted Mr. Nader's organization, Congress Watch, to find out which scientists were referred to, what they said, and under what circumstances. We were referred by Mr. Jim Cubie of Congress Watch on June 11, 1975 to Mr. John Abbot for the information.

Mr. Abbot advised us that the scientists and statements referred to were those made in the ECCS Hearings, and that he had available for reference a list of quotes supplied by the Union of Concerned Scientists.

It is a fact that the scientists and statements referred to by Mr. Nader are those cited in the record of the ECCS Hearings in the spring of 1972. It is also a fact that all critics were invited to testify before the Joint Committee on Atomic Energy in their hearings on nuclear reactor safety and that scientists who testified in the ECCS Hearings that they had reservations about the Interim Acceptance Criteria testified before the Joint Committee in January 1974 that they agreed with the December 28, 1973 ECCS Opinion of the Commission.

The implication in Mr. Nader's statement of May 8, 1975 that these views are held today is, at the very least, misleading.

9. *"The fragile nature of reactor reliability and the inability of the Federal government to competently regulate nuclear power was recently demonstrated by an accident at the Browns Ferry Station in Alabama. That accident was initiated when a hand-held candle started a fire in the polyurethane foam insulation surrounding some electrical cables. The fire led to the simultaneous failure of several redundant safety systems. It can be considered only a matter of luck that radiation was not released to the environment. The fire burned for seven hours, caused extensive damage at the $500 million reactor station, and will require the shutdown of two reactors for three to six months."*

The Browns Ferry incident is described in NRC press releases 75-69[13] and 75-79[14], and in Public Utilities Fortnightly, April 24, 1975.[15] Contrary to the statement that the incident was a demonstration of reactor unreliability and lack of competent federal regulation, we believe it actually demonstrated quite the opposite.

Concerning the statement on the "fragile nature of reactor reliability," it is a fact that:

(1) Although the fire resulted in damage to electrical cables under the control room, the reactor, core, coolant piping, and important structures were not damaged.

(2) At no time was there need to evacuate the control room. Operators were able to remain at their stations during the fire and afterwards.

(3) Both units were depressurized and shut down in an orderly manner, and the proper level of water in the reactors was maintained at all times.

(4) There was no release of radioactivity, and there were no injuries.

(5) Although control of some of the cooling systems that are normally used for cooling down the reactors was impaired or lost due to the effect of the fire on the cables, alternate methods of cooling were available and employed.

The fact is that the incident was handled in an orderly manner with no injuries or releases of radiation. There was sufficient redundancy built into plant systems to permit effective control of the entire situation, with a well-trained staff fully able to cope with the situation.

Concerning the remark on the competence of federal regulation of nuclear power, the requirements embodied in the federal regulations and extensive regulatory review process ensured sufficient redundant safety systems and a competent trained plant staff capable of shutting down the plant in a safe and orderly manner, with no consequences to the public or plant personnel. Thus, this incident actually demonstrates the competence of federal regulation.

We submit, therefore, that the fact that radiation was not released to the environment was not a matter of luck. Rather, it was the result of careful attention to safety and the incorporation of margins of safety in the designs to accommodate equipment failures and operator errors as required by Commission regulations. These provisions which assured that radiation was not released were backed up by an extensive regulatory review process involving many competent people from government, industry, and the academic community.

In the statement that the fire caused extensive damage at the $500 million reactor station, the suggestion is made that the damage was to the entire station. This is not the case. Preliminary investigation reports[13] indicate that there was considerable local damage to electrical cables, but no damage to the reactor core, coolant piping, and important structures as noted above. It is clear, therefore, that the damage was localized, and one can reasonably infer that the cost of repair will be a very small fraction of the $500 million cost of the station.

10. *"Even more shocking than the fact that a candle can cause a serious accident in a nuclear power plant, disabling a number of key safety systems, is the fact that the nuclear regulatory agencies were forewarned of this danger eight years ago by a fire in the polyurethane insulation of the Peach Bottom, Pennsylvania, nuclear power plant. The NRC's complex diagrams describing their "defense in depth" safety strategy cannot mask the fact that they often do not learn from their own mistakes. Can we expect the NRC's safety regulation of the breeder reactor, a much more dangerous reactor, to be any more successful?"*

As borne out on page 9, the Browns Ferry fire was not a serious accident. There was damage to some wiring but no injuries.

The Peach Bottom incident referred to is described in ROE:67-11, October 23, 1967[16] and occurred as the result of self-ignition of insulation covering piping and heat exchangers, not as the result of accidental ignition of a sealant used to plug cable tray openings, as was the case at Browns Ferry.

The fire which occurred about eight years ago at the Peach Bottom reactor therefore has little, if any, relation to the Browns Ferry incident. It was attributed to improper installation. Workmen did not follow proper procedures during application. The polyurethane foam insulation employed is usually applied in layers, with sufficient time between each application to permit the chemicals to cure. The application at Peach Bottom was made without curing time between layers and apparently the trapped heat led to self-ignition. The AEC (now NRC) did "learn its lesson" and issued appropriate recommendations in ROE: 67-11 to the nuclear industry.

On the other hand, the Browns Ferry fire was not due to either improper installation of polyurethane or ignorance of proper procedures. At Browns Ferry, a workman checking for air leaks accidentally ignited a sealant. The fire progressed and cables were damaged.

The nuclear industry did learn from the Peach Bottom incident, as evidenced by the fact that there have been no repetitions of incidents of this type.

11. *"But technical questions aside, the most powerful refutation of the nuclear industry's safety claims is the Price-Anderson Act. This Act limits the accident liability of a nuclear operator to a pittance of the potential damages. But if nuclear reactors are so safe, as the utilities and the NRC claim, why can't they be fully insured? To this question the nuclear industry has no satisfactory answer."*

We disagree with the assertion that the Price-Anderson Act is a refutation of industry safety claims.

Nuclear liability insurance is provided for under the Price-Anderson Act of 1957. In our view, this insurance provides more than adequate coverage to the public in the remote possibility of an accident. The three basic objectives of the Price-Anderson Act are: (1) to assure the availability of adequate funds to the public to satisfy liability claims in the event of a major nuclear accident, (2) to remove the deterrent of an uninsurable financial loss from private sector participation in atomic energy, and (3) to relieve persons with claims from having to prove fault in order to collect.

To meet these objectives, the Price-Anderson Act requires and makes provisions for utilities to buy $560 million in nuclear liability insurance. Currently, the utilities buy $125 million of insurance from private insurance pools and $435 million from the government. In addition, they buy property damage insurance in the amount of $175 million. It is important to realize that this insurance (certainly not a pittance) completely obviates the need for members of the public to carry insurance for protection against nuclear accidents. Damages incurred to the public from a nuclear accident, if one ever occurs, would be paid on a no-fault basis under the Price-Anderson Act.

Mr. Nader and others have questioned the fact that the Price-Anderson Act places a limit on liability. This is not unique, as commercial insurance companies also place limits of liability on the insurance sold to operators of commercial aircraft, dams, and tankers, to name a few. Furthermore, the Reactor Safety Study performed under the direction of Professor Norman Rasmussen of Massachusetts Institute of Technology and reported in WASH-1400 (Draft) concluded that the risks presented to the public associated with nuclear power are "very small" and that the likelihood of reactor accidents is much smaller than many types of non-nuclear accidents with similar consequences. Therefore, the likelihood of exceeding the public protection is exceedingly remote.

Furthermore, the San Joaquin Nuclear Project Committee estimated, using the results of the Rasmussen study, that the cost of insuring a nuclear power plant for the $40.5 billion damage estimated for the worst accident in the 1965 Brookhaven Institute draft update of WASH-740 would be only $40,500, because the probabilities of such an accident are so low. This amount would not offset the economic benefits which have already been demonstrated by existing nuclear power plants. [17]

However, in spite of this, it should still be noted that the $560 million is a limitation on required liability, not a limitation on all available protection. In reference to this situation, the Joint Committee on Atomic Energy stated, "...in the event of a national disaster of this magnitude, it is obvious that Congress would have to review the problem and take appropriate action." The history of other natural or man-made disasters, for example floods, tornadoes, etc., bears this out. The limitation of liability serves primarily as a device for facilitating further congressional review of such a situation rather than an ultimate bar to further public relief.

Mr. Nader also states that the Price-Anderson Act is a powerful refutation of the nuclear industry's safety claims. It is not.

The amount of coverage put up by the private insurance companies for nuclear power plants is the greatest commitment they have ever made for a single hazard. In addition, the private insurance companies have been continually raising the amount of liability they will provide. B. E. Lawton, Secretary of the Hartford Insurance Group, has stated that the very large amounts the insurance companies have extended for nuclear insurance constitutes a real vote of confidence in the industry.[18]

The experience of the nuclear insurance industry also refutes the argument that nuclear power plants aren't safe. Over the period 1957 to 1975, 68% of the $11.8 million in liability insurance premiums paid to private insurance pools has been refunded because of the excellent experience that has been obtained, because the plants are in fact safe. No portion of the premiums ($30/MWt/yr.) paid to the government is refundable despite the good experience. It is expected that property damage insurance premiums will be credited (reduced) by about 25% because of the same excellent experience. As noted above, the liability coverage provided by private insurance pools is increasing and is presently limited by market capacity, not by considerations of safety.

In testimony before the San Joaquin Project Committee, Herbert Denenberg testified that the "true" premium for the amount of nuclear liability insurance covered by the government would be $465,000 annually if covered by private insurance pools. The amount charged by the government for this insurance is $76,050. The Committee concluded that if the "true" cost of the insurance were included in a cost-benefit analysis, the additional $388,950 "does not appreciably change the economic benefits of nuclear power."[17]

12. *"In addition to the safety problems of present reactors (known technically as light water reactors), industry is beginning to recognize that nuclear power is an economic disaster. Because nuclear power plants are much more complex, they cost much more to construct than conventional plants. Their greater complexity also makes them more temperamental, and they break down more often than conventional plants. Nuclear power thus threatens to affect the utility industry and consumers who pay the final bills through a vicious cycle: Expensive and complex nuclear plants, which strain capital supplies, are unreliable. Their unreliability necessitates the construction of more power plants, which in turn strains capital supplies still more."*

We believe that nuclear power reliably provides economic benefits without parallel.

Although the initial capital costs of nuclear power plants are higher than comparably sized fossil fuel power plants, electric utility experience in general is demonstrating that electric power from nuclear plants costs less than coal or oil-fired plants. A recent survey [19] of 21 U.S. utilities shows that nuclear plants are producing electricity at a total cost (including amortized capital allocations) that is 40% less than that for fossil plants. This is primarily due to the lower fuel costs for nuclear power plants. This cost difference amounts to savings that benefit the consumers who pay the bills that are measured in hundreds of millions of dollars every year.

A comprehensive discussion in Public Utilities Fortnightly sets forth additional interesting facts on the consumers' stake in nuclear power that reinforce the proposition that it provides substantial benefits. The magazine surveyed 24 electric utilities which operate 42 commercial nuclear power stations in the U.S. Highlights of the survey follow.[20]

> "Nuclear generation saved customers of just the 24 responding utilities more than $750 million in their bills in 1974 alone as compared to paying for power from fossil (coal or oil) plants."

> "Power from the atom in 1974 saved the equivalent of more than 247 million barrels of oil, a step toward making the nation less dependent on imports."

On other aspects of nuclear plant operation, the Fortnightly said:

> "The reliability (availability) of nuclear plants exceeded that of generating stations using other fuels."

> "By making it unnecessary to burn coal and oil to meet consumer demands, the nuclear plants made an enormous contribution toward reducing air pollution. The displacement of these fuels also paid off with less strip mining and had other accompanying environmental benefits."

"Overall, by the end of January of this year, the nation's power systems had accumulated some 266 years of commercial nuclear operations without a single radiation accident which in any way jeopardized the public."

The very substantial economic benefits in favor of nuclear power are expected to extend into the future. Fossil fuel costs will increase relative to nuclear fuel costs and capital cost differentials are expected to narrow, particularly with the recent emphasis toward standardization of nuclear plants and streamlining the licensing process to cut construction times.

Nuclear power has proven itself to be an extremely economical power source when compared to fossil fuel generated electricity. The fact is that, according to the Edison Electric Institute, the amount of time which the fossil plants spend off-line is comparable to that of nuclear units. In a December 1974 report, [21] EEI reported that large coal and oil power plants were available on an average of less than 8-1/2 months for each year from 1964 through 1973. The same report showed that twenty nuclear plants were available over 9 months each year, or slightly more than comparably-sized coal or oil-fired plants. Thus, it is obvious that the reliability of nuclear units is at least comparable to fossil units and does not, because of differential unreliability, contribute to the need for constructing more plants. The misconception that nuclear power plants are less reliable than their fossil counterparts is due mostly to the fact that nuclear outages are more newsworthy than fossil outages and the public is more aware of them.

Moreover, those areas of nuclear power plant performance which have contributed significantly to a decrease in reliability are being examined and action is being instituted to eliminate those areas as sources of breakdowns.

Two reports recently relied upon by critics in an attempt to show nuclear plants to be unreliable were the September 1974 report to the Federal Energy Administration entitled "Nuclear Power Plant Reliability" by David Comey of the Businessmen for the Public Interest and a paper[22] entitled "A Critic Looks At Industry Credibility" by David Comey, presented at the Nuclear Power and the Public Conference of the AIF in February 1975.

In these reports, Mr. Comey drew the conclusion that capacity factors rise to a maximum between the third and fourth years of operation, but thereafter decline for each additional year of operation.

However, recasting all Mr. Comey's data into consistent and uniform one-year service intervals, it becomes apparent that plant capacity factors do not decrease linearly with age beyond four years of service.

Recently, Mr. Comey[23] published another BPI report entitled "Nuclear Power Plant Reliability - The 1973-1974 Record " dated February 14, 1975. In this document, Mr. Comey added data which he had previously omitted in his original report which showed reliability falling as plants get older. The latest version of his report shows (see Figure 1) a trend of increasing plant capacity factors as non-prototype nuclear plants mature into their operating cycle. If plants in their seventh service year, namely San Onofre and Connecticut Yankee, are added to Figure 1, this trend continues to climb upward, as shown by the circles.

The only commercial plants older than San Onofre and Connecticut Yankee are Yankee Rowe, Dresden I and Indian Point I. They are small, first generation (prototype) plants* which were placed into operation over 12 years ago. Although they have operated safely, they are not representative of present-day plants and it is not appropriate to predict the future operation of modern plants based solely on the past performance of these plants. Furthermore, each of these plants represented a different design approach toward the development of large-scale commercial power plants. The difference in their designs is reflected in their performance, as shown by the crosses added to BPI's Figure 1.

The performance achieved by Yankee Rowe over its lifetime demonstrates that high performance can be maintained as plants get older and proves that performance does not deteriorate simply because the plants get older. Since these three first-generation plants are the same age, the difference in performance must be due to inherent differences between the plants.

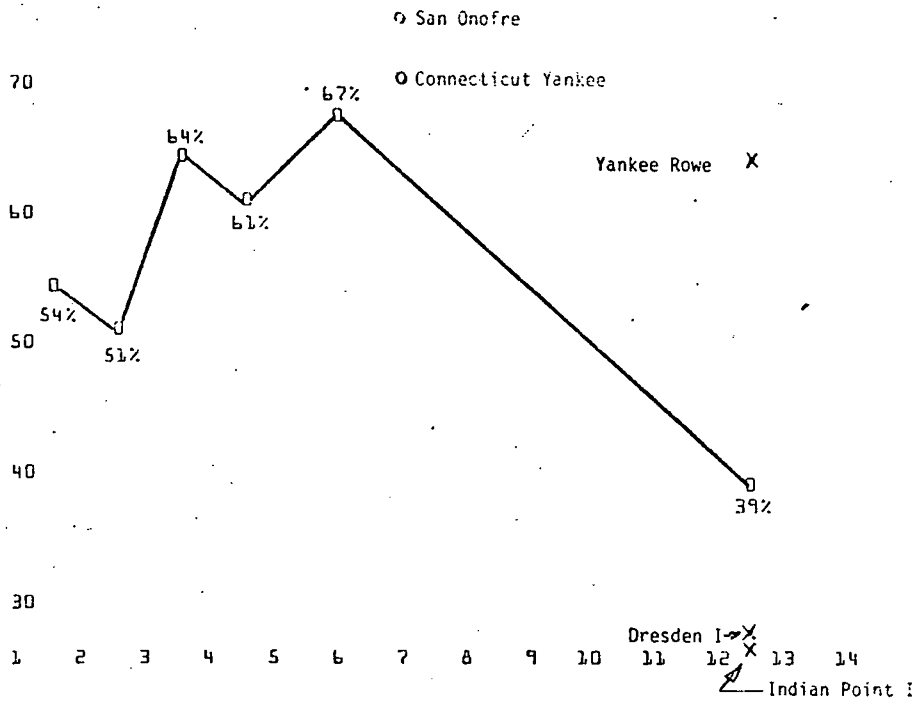
As a consequence, these allegations of nuclear power plant unreliability have no basis. Nuclear power has proven itself to have a reliability that is comparable to equivalent-sized fossil fuel power plants. Moreover, nuclear plants now coming on-line are benefiting from past experience and from engineering efforts to improve availability and capacity factors. By focusing on plant types which have demonstrated a high performance and by correcting those factors which have contributed to plant outages, we can expect to continue improving both availability and capacity factors in the future.

* Yankee Rowe, Dresden I, and Indian Point I are the first commercial nuclear power plants built by Westinghouse, General Electric, and Babcock and Wilcox, respectively.

FIGURE 1

NUCLEAR PLANT CAPACITY FACTORS VS. AGE OF PLANT

1973-74



ABSCISSA = YEARS OF COMMERCIAL SERVICE OF PLANTS

ORDINATE = AVERAGE PLANT CAPACITY FACTOR IN PERCENT

SOURCE: TABLE 3

Taken from EPI-7507 dated February 14, 1975

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13. *"Even if nuclear electricity could prove economical to private utilities, it would be only because of massive federal subsidies and economic distortions."*

The matter of nuclear plant economics is discussed on pages 11-20.

It is true the American people have a large investment in the form of federal subsidies in nuclear power. It is also true that this investment, along with considerable private investment, has led to the development of an industry that produces about 8% of the electricity generated in this country, and this percentage is increasing. This investment is now paying off large dividends in savings on electricity bills and by providing a ready alternative to oil and gas. We submit, therefore, that counseling against the full utilization of nuclear power does not represent the best interests of the consumer.

14. *"These distortions include limited insurance liability which permits utilities to pay only a fraction of true insurance costs."*

See comments on pages 11-13.

15. *"Uranium enrichment, which is provided as (sic) reduced cost by government plants..."*

The cost of uranium enrichment presently charged by the government is, indeed, less than the costs which have been projected for new enrichment plants. However, this difference does not represent a subsidy in that the enrichment service charges are designed to assure recovery of appropriate government costs. The AEC proposed in 1970 that its charges for enrichment services be on a more truely commercial basis. However, the Atomic Energy Act of 1954 [Section 161(V)] provides that the prices established be on a basis which will provide recovery of costs to the government. It was the intention of the AEC[24] to prepare proposed legislation that will permit establishing prices on a commercial basis. Until such legislation is passed, the basis for enriching charges will remain as follows:

> "...AEC's charges for enriching services will be established on a basis that will assure the recovery of appropriate Government costs projected over a reasonable period of time. The cost of separative work includes electric power and all other costs,direct and indirect, of operating the enrichment plants; appropriate depreciation of said plants; and a factor to cover applicable costs of process development, AEC administration and other Government support functions, and imputed

interest on investment in plant and working capital. During the early period of growth of nuclear power, there will be only a small civilian demand on the large AEC enrichment plants. These plants were originally constructed for national security purposes, but will be utilized in meeting future civilian requirements. In this interim period of low plant utilization, the Commission has determined that the costs to be charged to the separative work produced for civilian customers will exclude those portions of the costs attributable to depreciation and interest on plant investment which are properly allocable to plant in standby and to excess capacity."[25]

Since these enrichment plants were built over two decades ago, their capital cost is, of course, much lower than what equivalent facilities would cost today. Operation of such facilities under private ownership also entails costs not included under government ownership, such as taxes and a return on investment. The structure of the enrichment organization (i.e., government utility consortium, private, etc.) and the assumptions used concerning financing arrangements all affect the cost of the enrichment service.

The cost of enrichment today does not represent the cost that the industry expects to pay in the future for the reasons cited above. But neither does it represent a subsidy by the government since the service is being priced on a full cost recovery by the government.

16. *"Reprocessing is made possible by government support for recovered fuel prices."*

The reprocessing of spent nuclear fuel to be carried out in commercial facilities at commercial rates is one part of the fuel cycle and is of course primarily done to recover the unused valuable uranium and plutonium present. However, it must also be recognized that reprocessing also represents the first step in the waste management program designed to deal with the unwanted waste products. Both of these considerations are inherent in the reprocessing step. Because of their value as an energy resource, the recovered uranium and plutonium represent a credit which is generally greater than the cost to reprocess the fuel. However, even if it were less, the recovery and recycle of these materials still represents a significant reduction in the cost of generating electricity.

The statement that the government provides a support for recovered fuel prices does not consider the realities of the industry. Prior to January 1, 1971, the AEC did provide a guaranteed "buy-back" price for plutonium at a price that was considered representative of the true value of the plutonium. Today, the value of the plutonium is set by its intrinsic value as an energy resource and is not provided government support.

Lately, criticism has been leveled at the enrichment charges because no penalty is included for the presence of the U-236 isotope in the uranium recovered from the spent fuel. This U-236 isotope acts as a "poison" to the nuclear power production process and, therefore, its presence in the uranium reduces the intrinsic value of the recovered uranium as an energy resource.

The industry has long recognized this factor in recycling the uranium but the present absence of a penalty charge by the government when the material is re-enriched should not be taken as a subsidy. Presently the quantity of such material that has been recovered and recycled has been very small and will remain so until the reprocessing plants become operational and significant quantities of such uranium are recovered for use. Until such time, there is no government support, since in practice there is no material. Much has been written in the industry regarding the penalty associated with the U-236 isotope and it is fully expected that appropriate government action will be taken at that time to establish a realistic surcharge for the re-enrichment of the recovered uranium.

17. *"Security guards and waste storage are services which will be provided by the government."*

The Energy Reorganization Act of 1974 which established the NRC and ERDA also imposed on the NRC the duty to review safeguards for materials and facilities licensed under the Atomic Energy Act of 1954 with the intent of "assessing the need for, and the feasibility of, establishing a security agency within the office for the performance of the safeguards functions..." The NRC, in accordance with the Act, is conducting a study on safeguarding nuclear materials. Since this study will not be completed until February 1976, it is inappropriate to prejudge whether or not the NRC will recommend the formation of such a safeguards security force, nor is it clear that if such a force is established it will be operated as a subsidy to the nuclear industry. All of these are factors which will be included in the study of the alternatives available to the NRC.

In early 1971, the AEC established the policy [26] that for public health and safety considerations, disposal of high-level radioactive fission product waste materials would not be permitted on any land other than that owned and controlled by the federal government. Temporary storage of the spent fuel, either at the reactor site or the reprocessing plant prior to reprocessing, is the responsibility of the nuclear industry and such services are not provided by the government. After reprocessing, the separated fission products are stored temporarily at the reprocessing plant before they are to be solidified and within a specified time period transferred to a federal repository.

The transfer of these waste materials to the custody of the federal government does not, however, represent a subsidy to the nuclear industry. As stated in the AEC's policy:

> "Upon receipt, the Federal repository will assume permanent custody of these radioactive waste materials although industry will pay the Federal Government a charge which together with interest on unexpended balances will be designed to defray all costs of disposal and perpetual surveillance."

A concept that has been proposed by ERDA is to establish Retrievable Surface Storage Facilities (RSSF) for the interim during which the various alternative methods of providing permanent disposal are thoroughly investigated. Under such an arrangement, the charges paid by the industry would be sufficient to cover both the cost of the RSSF and eventual transfer to permanent disposal. Under such a policy, it is obvious that the federal government will not provide a subsidy to the nuclear industry.

18. *"In spite of all the direct and indirect subsidies of nuclear power, the industry is in danger because the nuclear fuel cycle which supports the power plant is crumbling."*

As with many other businesses today, portions of the nuclear fuel cycle are faced with problems of expanding to meet anticipated demands during an era of tight financing and regulatory uncertainties. However, to say that the fuel cycle is "crumbling" is an improper description of the situation.

The "front end" of the fuel cycle (including mining, milling, conversion, enrichment and fabrication) is certainly faced with possible short-term problems in supply and facility capacities. The required technology, however, is well known and demonstrated. For the most part, the solutions are those of providing proper incentives and reducing the uncertainties in the projected growth rate of the nuclear industry. The enrichment step involves special problems in adding the unit of capacity. This is because of the high capital intensive nature of this step in the fuel cycle and because of the difficulty in selecting the best of the alternatives available for the next enrichment plant. The difficulty of raising sufficient capital within the private sector is one of the reasons that Westinghouse has recommended the next enrichment plant should be an add-on to one of the present government-owned plants.

In discussing the problems associated with the "back end" of the nuclear fuel cycle, it is important to remember that a complete commercial fuel cycle has already existed. Indeed approximately 600 tons of spent fuel were reprocessed at the Nuclear Fuel Services Plant. Plutonium has been recovered and refabricated into fuel in significant demonstration quantities. Today the technology does exist to permit the nuclear industry to move ahead with constructing and operating the necessary facilities to close the nuclear fuel cycle on a true commercial basis.

The real problem with the "back end" of the fuel cycle is regulatory in nature. Until the NRC has completed its generic environmental review of whether plutonium recycle should be permitted or not, the industry cannot proceed with its plans for the necessary facilities. Recently the NRC published its provisional views on the procedures it plans to follow in completing these generic reviews. If followed it appears that there would be approximately an additional three-year delay before a final regulatory decision on plutonium recycle would be made. The industry is, of course, opposed to such continued delays and stands ready to provide the information necessary to aid in completing the NEPA review process.

19. *"There are no reprocessing plants now operating and the plants under construction will probably not begin operating until 1977. Because no reprocessing plants are operating, wastes are building up in the temporary storage facilities at reactors. The buildings have become such a problem that ERDA has threatened to shut down existing reactors. The nuclear industry like the Japanese sailors who used dirty socks to stop a reactor radiation leak on Japan's first nuclear ship, is casting about for ways to 'extend temporary storage capabilities.'"*

The fact that there are no reprocessing plants operating at this time does not limit the operation of nuclear power plants. But certain decisions can and must be made by the NRC so that actions necessary to prevent limitations on the operation of nuclear plants can be taken. Such actions include the increasing of fuel storage capacity of nuclear plant spent fuel storage pools and expediting the licensing of Barnwell. If Barnwell becomes operational in 1976, no reactors will have to shut down.[27]

The statement concerning the radiation leak on Japan's nuclear ship is completely unrelated to waste disposal problems.

20. *"The most crucial problem of all -- 'What is to be done with radioactive wastes that are toxic for 250,000 years' -- remains unsolved today in spite of twenty years of promises and the claim that disposal is 'only an engineering problem.'"*

This is not a new issue, since radioactive wastes from the weapons program have been handled without harm to the public for the past 30 years.

New regulations[26] require that these wastes be solidified in unleachable form within five years of their separation. This will avoid any consequences of liquid leakage from tanks.

Engineered surface storage facilities currently under design will provide safe interim storage and permit recovery for either beneficial uses or ultimate storage.

Ultimate storage will be in deep salt bed formations which will result in almost no risk to the general public.[28] The very presence of salt formations indicates that the area has been geologically stable and free of moisture for hundreds of millions of years, and indicates they are likely to remain so for millions of years to come. An initial pilot plant demonstration of the salt bed storage will be implemented in the early 1980s.[29]

In addition, the amount of solidified waste to be handled will not be so great as to proliferate the country with storage or disposal sites. Through the year 2010, the total volume of high level solidified waste committed to storage or disposal will be equivalent to a cube less than 30 yards on each side. Only one surface storage facility or one salt bed disposal site would be required to safely handle this amount of waste.

There is a problem -- but the solution exists. There is no rush to implement the plan on a large scale because we do not have large amounts of commercial reactor generated waste yet, and wastes will not be generated in large quantities until spent fuel reprocessing plants begin operating several years from now.

21. *"There are as many solutions to permanent radioactive waste disposal as there are nuclear proponents, but when each solution approaches implementation it proves unworkable."*

As stated above, there is a plan, there is a solution -- solidification of waste followed by either interim surface storage and then ultimate disposal in salt beds, or simply ultimate disposal in salt beds. This is certainly not a multitude of solutions. This plan has not proved unworkable since its implementation will not be required for several years, when large amounts of solidified wastes are generated.

22. *"When our sewer systems become so overloaded that treatment plants cannot deal with the wastes, we impose sewer moratoriums and allow no new sewer connections. Does not rational social policy require that until the radioactive waste problem is solved, no new construction of nuclear power plants should be permitted?"*

The radioactive waste problem does have a solution. The implementation of this solution must await the generation of the solidified waste from currently operating nuclear plants. The stated analogy, "When our sewer systems become so overloaded that treatment plants cannot deal with the wastes, we impose moratoriums and allow no new sewer connections," has no meaning relative to the radioactive waste issue. Our radioactive waste disposal system is not overloaded. It is not even loaded yet, and will not require loading for some years to come. Thus, it is meaningless to suggest a stop in nuclear plant construction unless there is some reason to do so other than the radioactive waste issue.

Even if commercial nuclear power plants did not exist today, we would still require a radioactive waste management program to handle the wastes from the military program. In fact, if commercial nuclear power plants increase in numbers as we see required in the future, the wastes from these plants will not be equal to the currently existing military generated wastes until near the end of this century.

23. *"Before this country begins its headlong rush to develop the breeder reactor ..."*

Mr. Nader incorrectly states that the U.S. is about to "begin its headlong rush to develop the breeder reactor." In actuality the U.S. breeder development program has been active since before 1950 and has moved carefully and cautiously to today's situation where the technology is developed and available. Only demonstration in a utility environment remains before commercial breeder plants can be operating on utility networks -- in time to preserve the option of economic nuclear energy.

Since 1951, six experimental or test liquid metal cooled breeder-type reactors have operated safely in the U.S. In fact, the Experimental Breeder Reactor I, in 1951, produced the first nuclear generated electricity in the world. This was followed by the Sodium Research Reactor (SRE) in 1957, the Hallam reactor in 1962, the Fermi reactor in 1963, EBR-II in 1963 and the Southwest Experimental Fast Oxide Reactor (SEFOR) in 1969. EBR-II has operated safely for over ten years and is still producing electricity.

In addition, there have been many experimental and test breeder reactors operated safely in a half-dozen foreign countries, and larger power producing breeder plants have been operating in France, the U.K., and the Soviet Union.

The LMFBR has been the top priority energy development program for many years in France, the U.K., the Soviet Union, West Germany, Japan, and Italy.

24. *". . . it is logical to note the problems of the LWR and ask if the breeder will solve these problems. The answer is that it will not."*

The breeder reactor will solve the major real problem with light water reactors (LWR), which is that LWRs use only about 1.5% of the energy available in natural uranium. The breeder, however, uses uranium much more efficiently, using 60 to 70% of the available uranium.

Present ERDA data[30] indicate that we have 700,000 tons of known high-grade uranium ore reserves in the U.S., and an additional 2.7 million tons of potential (unidentified) high-grade resources.

The known reserves of high grade ore are estimated to be committed to fueling, for their lifetime, light water reactors operating by the early 1980s, and if we find the additional high grade potential resources, they will be committed to fueling light water reactors in operation by the mid 1990s.

The liquid metal fast breeder reactor (LMFBR) will use uranium 60 times more efficiently than present generation reactors, and extend from decades to centuries the period during which our uranium resources can provide economical electricity.

If we do not have a commercial breeder by the time we approach depletion of our high grade uranium resources, we will be forced to mine significant amounts of low grade ores, probably the Tennessee shales, with a resultant environmental and economic penalty. Another option, if environmental pressures prevent stripping the shales, will be to become dependent upon foreign uranium[31] probably available for import only in enriched form, at highly inflated prices due to high world-wide market demand for uranium towards the end of the 1990s. However, this would put us in the same position of vulnerability to blackmail that presently exists relative to the OPEC states and oil.

These costly consequences can be prevented if we have the LMFBR ready for commercial operation by the 1990s. Instead of having to strip for low grade uranium shales or import uranium, the LMFBR will provide us with electricity to drive an electric economy with no additional mining to meet its fuel requirements. Plutonium from light water reactors will provide the initial core fuel and depleted uranium tails (220,000 tons are stockpiled already) will provide all the fertile material needed for breeder reactor operation throughout the next century, if needed. In fact, the energy content of the presently stockpiled uranium tails, when used in breeder reactors, is equivalent to five times the energy content of all the estimated Arab oil.

25. *"The fuel for the breeder will be plutonium, one of the most toxic elements known to man".*

Plutonium is considered to be toxic, but plutonium is far from being the most toxic substance when compared to many other elements or compounds which are more available and safer to handle. This statement applies to toxicity arising from either radioactivity or chemical properties.

Toxicity from radioactive elements is a function of longevity or half-life, of the radioactive state among other factors. This toxicity per unit of mass is usually greatest with elements exhibiting the shortest half-life. Radioactive elements normally present in the earth's surface undergo radioactive change to other material forms with half-lives less than one-billionth of plutonium's half-life. Not only are these elements potentially more toxic than plutonium, but this natural radioactivity also provides an experience base for setting maximum exposure limits for plutonium.

Those proficient in the field of radiation health and safety emphasize that more is already known today, through comprehensive studies, about toxicity potential of plutonium than all of these other naturally-occurring radioactive elements. Thus, limits can and have been established for potential plutonium exposure with large safety factors and at high degrees of reliability and confidence.

Materials such as lead, potassium and mercury are known to be dangerous to man because of a chemical toxicity property. In comparison, here again, plutonium is far from the most toxic. For instance, compare estimates of 50%-lethal doses for some materials if administered orally:[32]

Lead arsenate	-	0.1 gm
Selenium oxide	-	0.3 gm
Plutonium	-	1.15 gm
Caffeine	-	14 gm

Note that plutonium is about 1/10 as effective in causing death as lead arsenate, the worst case above. Furthermore, a material to which most of us subject ourselves willingly each day, caffeine, is considered to be only 10 times safer than plutonium when comparing lethal doses.

26. *"Less than one-millionth of a gram of plutonium has caused cancer in laboratory animals".*

Plutonium has caused cancer in laboratory animals, yet no cancer in any human has been attributed to this material. Two factors are most important in further clarification of this issue. First, the actual performance of the laboratory tests on animals has provided useful information in evaluating human exposure limits. Although not directly applicable to humans, the test results support the limits set for humans as adequate health measures. Thus, a rather large data base has been available for setting limits while many other industrial standards are established without the benefit of much relevant testing background. Continued testing with animals should be encouraged, however, to provide even more knowledge on this important aspect of public health.

The second factor is that plutonium exposures to humans during the national emergency conditions of the early nuclear weapons industry far exceeded levels established as maximum limits today. Even so, examinations of these individuals have not revealed any health problems related to this early plutonium work. In fact, of the 17,000 plutonium workers, including those engaged in the Manhattan Program, none have died of plutonium-related health problems.[33,34]

27. *"Plutonium is also the raw material of nuclear bombs".*

Plutonium is used for military weapons. Uranium is also used in military weapons, and TNT and other materials have been employed in bombs as well. Only in a Utopian dream is removal of all war material from the face of our earth conceivable.

Prohibition of a commercial plutonium industry in our country would be counter-productive economically. Other countries would achieve the commercial benefits, and the material could be brought clandestinely into the United States for bomb-making. The answer then, is effective anti-theft laws and adequate protection for this material in all countries.

That protection task is really not formidable as evidenced by success in prevention of theft of nuclear weapons for over 30 years. Furthermore, plutonium already in weapons form, or even in metal form, will be considerably more appealing to those desiring a bomb ingredient than would the liquid or ceramic forms available in the commercial power industry.

Also, as discussed on page 34, the plutonium used in military weapons differs significantly from the plutonium produced and used in commercial nuclear reactors. This results in clandestine handling of reactor grade plutonium being much more difficult and dangerous to the person handling it.

28. *"The coolant for the breeder will not be water but sodium, a highly corrosive substance which can react explosively with air or water."*

The coolant for the breeder is sodium because of its high thermal conductivity, the ability to use low operating pressures, and the fact that under the conditions of use in the operating reactor, sodium is much less corrosive than water in the light water reactor at its operating conditions. Therefore, it is easier to design for the sodium coolant. Moreover, although it is true that sodium can react chemically with air or water, neither of these latter substances are present within those areas in which radioactive sodium is employed. Water concentrations in the atmosphere are maintained at a parts per million level and air is excluded by the use of inert gas atmospheres around piping which contains sodium. Even if sodium came into contact with air, it would require temperatures above some 450 to 500°F before the fire could proceed, and in no identified case in a sodium cooled plant can sodium react explosively. At worst, a fire would result which could be extinguished.

29: *"The breeder reactor can experience an accident known as the Core Disruptive Accident. In everyday languange, this technical euphumism means that the breeder can blow up."*

A breeder reactor cannot experience a core disruptive accident with any credible probability.[35] For such an accident to occur, it would require an initial accident, such as loss of power, plus a simultaneous failure of all redundant shutdown safety systems. Even then, the best technical expertise available at this time indicates that an energy release from a damaged core would be negligible. Even if an energy release could be postulated, it would not be an explosion of the violence found in a chemical reaction which is characterized by high shock and low residual pressures. Even assuming the worst thing to happen at each stage, the best information to date would project damage to the core assemblies, and adequate cooling of that debris within the intact primary system.

30. *"The breeder reactor threatens to undergo accidents that explode the reactor and release deadly plutonium. The catastrophic effects of a serious plutonium breeder accident could then exceed the catastrophic accidents possible with our present light water reactors."*

Since the reactor cannot "explode", plutonium cannot be released in the manner the testimony implies. The accident analysis includes highly conservative assumptions in order to evaluate containment designs; for example, it assumes that plutonium release acts like a gas rather than a particulate in escaping from containment volumes, but even then a postulated plutonium release is minor to guidelines for site doses. Both light water reactors and plutonium-fueled breeder reactors comply with identical regulatory guidelines for site boundary doses in these hypothetical accident conservative calculations and, therefore, neither is significantly worse than the other.

31. *"But, the American Physical Society, in its review of the AEC's Rasmussen reactor safety report, released April 28, 1975, found the Rasmussen reactor safety report has badly underestimated the consequences of a nuclear accident. The Physical society concluded that a reactor accident would cause 10,000-20,000 deaths, 22,000-350,000 injuries, 3000-20,000 genetic defects plus widespread and enduring land contamination.*

In August 1974, the AEC issued the "Draft Reactor Safety Study" (WASH-1400), culminating two years of work by a group of scientists under the direction of Professor Norman C. Rasmussen of MIT. Because the subject of this report is extremely complex, i.e. the risk assessment of Nuclear Reactor Plants, the report was issued in draft form to permit review and comment by interested and knowledgeable persons in order that the final version of the report, when issued, could be as accurate and authoritative as possible.

The American Physical Society (APS) issued in April 1975 the "Report to the American Physical Society by the Study Group on Light-Water Reactor Safety." This report represented the results of a year-long study by a dozen part-time participants with various levels of prior experience in the reactor field. As part of its study of LWR safety, the APS calculated the consequences of the "reference accident" considered in the Reactor Safety Study (RSS) -- the melt-down of a 1000 MWe PWR with a subsequent failure of containment. As could be expected when dealing with such a complex problem as estimating the consequences of a postulated reactor accident, there were substantial differences in the results of the APS study from those of WASH-1400. In general, the numbers of deaths and injuries were calculated to be higher in the APS study than in the RSS.[36]

As was their intent in issuing a draft report, the Reactor Safety Study group is currently reviewing the APS report along with all other comments received. In testimony before the Subcommittee on Energy and Environment on April 29, 1975, Professor Rasmussen, Director of the RSS, stated that the APS, because it did not have a long time to do the analysis, had made some approximations, one of which "seriously exaggerated these effects in the case of the average accident."[37] The number used in the APS report for population density resulted in an overestimation of the consequences by five times in the average case. Rasmussen further testified:

> "That one factor of 5 means there is only a factor of 5 difference between our answers [the RSS and the APS] and there are several other places where we think they have exaggerated the effect of this somewhat, points we could argue on, but I think we have a very substantial case that will show that our answers are not going to be different by much more than a factor of 5 from the original case [Draft WASH-1400]."[37]

Thus, Rasmussen believes that even after all the comments received, including those in the APS report, are considered and incorporated in the final Reactor Safety Study report the results will not differ by more than a factor of 5 from the results of the "Draft Reactor Safety Study."

However, risk assessment is much more than calculating the consequences of accident. The environmental risk presented by nuclear power plants is equal to the product of the consequences of an accident and the probability of the accident occurring. The "reference accident" considered by both APS and the RSS is indeed a severe accident with severe consequences. However, the probability that the accident will occur is extremely small -- less than 6×10^{-6} per reactor year. In addition, the APS estimated that even if the accident occurred, the probability that an individual in the exposed region (estimated by APS as being a 0.25 radian sector of radius 500 miles) would die during his natural lifetime from cancer induced by his exposure is one chance in a thousand.[36] Rasmussen testified that, even now, with the comments on the draft RSS report in (including those from the APS),

> "In summary, the review process has provided us with many useful comments that will result in a better, more understandable final report. However, as of now we see no changes large enough to alter the basic conclusion of the report which is that the risks from accidents in the operation of nuclear power plants of the type being installed in the United States today are very small compared to other risks which society accepts."[37]

32. *"Evidence recently has come to light that the same bureaucratic-corporate forces that undercut the light water reactor safety program, have put tremendous pressure on the NRC not to require necessary safety systems in the even more dangerous plutonium breeder reactor program."*

This statement is misleading since the CRBR* Project has in fact initiated, for the first time ever in reactor plant licensing, a reliability program[35] of immense proportions in order to demonstrate the real, first level safety of the design and its safety systems. NRC has never required this confirmation by a reliability program, and the only pressure of the regulatory branch is the need to judge the acceptability of such a reliability confirmation, provided over and above any regulatory requirement for the licensing of this plant. NRC has not previously had to do this. There is no pressure on NRC not to require necessary safety systems.

*Clinch River Breeder Reactor - a liquid metal fast breeder reactor demonstration plant is to be built near Oak Ridge, Tennessee, and produce electricity for the TVA network.

33. *"The purpose of the CRBR is to demonstrate the viability of the plutonium breeder concept. The proposed contractual arrangements permit the utilities to pull out of the CRBR project if a basic design change is ordered."*

The basic conditions of the revised contractual terms between ERDA and the Utilities have been presented to Congress and the detailed contractual wording is in negotiation. In these proposed terms, ERDA is given basically full management control over the future of the Clinch River Breeder Reactor Plant. The Utilities agree to continue with their contribution, presently estimated at $258 million, and have license to information developed during the course of the Project. The agreement is based on the premise that the Project will continue in basic conformity to the Reference Design, which was published in June of 1974 and approved by the Project Steering Committee in August of 1974. Should ERDA desire to make significant changes to the existing approved Reference Design, then the approval of the Utilities must be sought. Should ERDA choose to unilaterally impose a change to the Reference Design, then the Utilities have the option of withdrawing their financial support. The purpose of this arrangement is to assure that the Clinch River Breeder Reactor Plant remains a demonstration plant of a type the Utilities would desire in their systems.

34. *"One of the purposes of a core catcher, which a number of independent scientists believe is an essential safety feature if breeder reactors are built at all, is to stop a secondary nuclear explosion from occurring after an accident occurs."*

The present CRBRP reactor is designed with reliable shutdown and shutdown heat removal safety systems with a confirmed reliability which shows that severe accidents cannot occur with any credible probability. The Project and its technical consultants do not believe, therefore, that additional hypothetical safety features of unknown worth are required. One of these so-called safety features is a core catcher, which has to presume that all safety systems fail, and that the accident proceeds in the worst possible manner before its use is invoked. Moreover, its operation depends critically upon the mode of this latter accident sequence and the provision of such a core catcher can well have damaging consequences on real plant safety. Nevertheless, the CRBRP is at the present time committed to a parallel design approach, one branch of which is designing and evaluating the possible use of a core catcher in case the relability program fails to confirm the high reliability of the safety systems. The use of a core catcher is not to prevent "secondary nuclear explosions" but merely to provide a backup cooling system for postulated debris. It is in no sense "essential", since reliable heat removal systems already exist in the normal design of the plant.

35. *"The GAO report notes that 'There are strong indications that the utility participants are opposed to including a core catcher in the CRBR design.' Of course, if a core catcher is required and as a result the utilities pull out of the project, the viability of the plutonium breeder concept as a source of power for utility companies will not be demonstrated. The purpose of the breeder demonstration project is to show that the breeder program can be commercially viable -- that is, that the utilities are willing to invest in plutonium breeders as a major source of electric power. If the utilities pull out as a result of NRC's requirement of a core catcher, the entire rationale for the Clinch River program will be negated."*

This suggests that the Utilities may withdraw their support of the Clinch River Breeder Reactor Plant in the event that a core catcher is required by NRC. Certain Utilities executives have publicly stated their opinion that core catchers are not and should not be required for LMFBRs. The Project itself believes that the CRBRP will not cause an undue hazard to the health and safety of the public, and that the plant will be successfully licensed without the necessity of a core catcher. Should NRC eventually determine otherwise, there may be some attrition or withdrawal of Utilities' support, although this is by no means certain. The reason that is advanced by some Utilities executives is that a plant which has sufficient potential for major accidents to require a core catcher would not be suitable for obtaining public acceptance on their systems. It is clear that an NRC requirement for a core catcher would, at the least, impose an impediment to the commercialization of the LMFBRs.

36. *"There will have to be tens of thousands of over the road shipments of plutonium per year from reactor to reprocessing plants to fabrication plants and back to the reactors".*

Tens of thousands of shipments of nuclear fuel per year are expected during the 1990s and beyond. Since adequate security protection will be provided, no problem is envisioned with this transportation task.

Conversely, the nuclear option to generation of power will relieve the transportation industry of what might have been an insurmountable burden in hauling fossil fuels. Note the data comparison below for a single gigawatt of electrical generation:

	Loads per year[38]	
	Nuclear	Coal
Fuel to reactor	6 truckloads	38,300 railcars
Plant solid discharge	60 truckloads	36,500 truckloads

These values speak for themselves. Without nuclear power generation, transportation may well be impossible, or at best, unacceptably expensive and detrimental to the environment.

37. *"In September 1974 Science magazine investigated the record of the four major commercial plants which have handled plutonium. The article concluded:*

> *'......it is hard to see that any of them is quite in command of the technology'."*

The comments on operation of the nuclear industry during the 1960s emphasize some isolated incidents in four pilot-scale plutonium plants. Violations of regulations did occur, as happens in every industry. The problems of imposing new EPA and OSHA regulations across all industry illustrate comparable situations. A pertinent question is to what standard should the nuclear industry be compared for evaluation. The truth is that the nuclear industry has a better operational safety record than just about any other major industry. Results must be measured in terms of injuries, fatalities, and danger to the public, and we are proud of our safety record measured in that manner. No death, injury, or disease of a plutonium worker has been attributed to plutonium exposure. In contrast, the coal industry, which is the primary fuel alternative to nuclear power, is experiencing about 5 new cases of pneumoconiosis (black lung) per thousand man-years.[39] The coal record also reveals 500 occupational deaths and 20,000 injuries per year.[39] On our basis for comparison on equivalent capacity levels, the nuclear industry is far superior to this competition.

As the plutonium segment of this nuclear industry matures, regulations will be standardized and plants will be considerably more automated. These changes will reduce the number of regulatory infractions as cited in the referenced article. The safety record will be maintained as a target for excellence throughout all industry.

38. *"If just 10-20 pounds of plutonium are stolen, it could be fabricated into an illicit nuclear weapon by a dedicated and skilled band of terrorists. This weapon, which could be carried in an automobile, would have an explosive potential of 100 tons of TNT."*

Plutonium by itself as plutonium-239 does not and will not exist in the nuclear fuel cycle. The breeder reactor fuel will be a mixed oxide of plutonium and uranium, and anywhere from 200 to 900 pounds of this mixed oxide fuel would be needed to form a critical mass necessary for a bomb. After the spent breeder fuel is reprocessed, plutonium as plutonium oxide would be present. Twenty-five to seventy pounds of this material would be required to construct a bomb. However, the fabrication of such a device would be difficult and dangerous to the fabricator, if he were ever able to get the plutonium.

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Designing a nuclear bomb is possible, given sufficient technical expertise and available literature. But to actually handle, process, and build a nuclear explosive device from reactor-grade plutonium would be both very difficult and very dangerous. In fact, any individual or group attempting to construct a weapon without sophisticated facilities would probably become extremely ill well before the task was completed.

Military nuclear weapons are made from what's called "weapons grade" plutonium. It is metallic and composed almost entirely of Pu-239 which is primarily alpha emitting. It is relatively safe to handle. In the commercial nuclear fuel cycle, metallic plutonium will never be present.

"Reactor grade" plutonium contains large amounts of Pu-240, 241, and 242. This results in significant penetrating fast neutron, gamma, and beta radiation which presents a severe personal health hazard to anyone who would attempt to handle this material without the necessary protective equipment. The neutron activity also precludes the use of the simpler "gun barrel" explosive design, thus necessitating use of the much more complicated "implosive" device.

Even assuming that plutonium would be available, it would take an individual or group with extensive knowledge in several areas of physics, engineering, metallurgy and machining to design a nuclear weapon. In addition, he would need significant instrumentation, tools, shielding, and chemical processing facilities to even begin construction.

Even with the proper elements, tools, and expertise, it is very difficult and dangerous to construct a nuclear weapon.

It took the Indian government (with a national commitment, all necessary facilities and personnel, and no obstacles to obtaining plutonium) nearly a year to construct a bomb after they had obtained the required amounts of plutonium.

Adequate protection against diversion of plutonium and other special nuclear materials is provided. Safeguards procedures have already been imposed on the commercial nuclear industry to protect against the theft of nuclear materials, including special security measures during transportation. The federal safeguards program is dynamic and includes continuing evaluation and upgrading of safeguards systems, as well as implementation of new safeguards as conditions warrant.

Theodore B. Taylor, who has been the most outspoken critic of the plutonium safeguards system, is today pleased with progress made over the past two years, and he has stated[40] that he believes that with the recent improvements and currently proposed upgrading our safeguards program will be satisfactory before significant amounts of plutonium begin to flow through the nuclear fuel cycle.

39. *"A recent NET television program illustrated this dangerous potential. As part of the program, the producers commissioned an average undergraduate science student to design a nuclear bomb. The student, in a short period, designed a bomb which experts from the Swedish Defense Ministry judged would probably explode."*

This statement refers to a recent NET TV program, "The Plutonium Connection", where an actor protrays a student who developed a design, on paper, of a nuclear bomb with a plutonium core. As addressed in the previous point on page 33, it's two completely different things to design a bomb, and actually build one. Mr. Nader states that "the student -- designed a bomb which experts from the Swedish Defense Ministry judged would probably explode." This design was not evaluated by anyone who ever built a nuclear weapon. The evaluation was performed by Swedish scientists who have not produced a weapon. Thus, they can not be considered qualified to say whether any design, if built, would actually explode.

"The Plutonium Connection" was not a balanced presentation of the issue. It was anti-nuclear biased, and appeared to have been edited to achieve a dramatic argument for a preconceived conclusion.

Mr. Samuel Edlow, President of Edlow International, who was interviewed for the program has claimed that, through editing, his own statements have been distorted and taken out of balanced context; he terms the production "a marvelous anti-nuclear propaganda film."

Even Ted Taylor, who is a star of the film, has stated that he does not agree with all the points made. He has stated recently in an article in "Aware" magazine and a presentation given at the October, 1974 Atomic Industrial Forum Conference that he is pleased with the improvements made over the last two years in the safeguards area, and he feels that a safeguards system satisfactory to him can be achieved before significant amounts of plutonium flow through the nuclear fuel cycle. Also, he does not believe that the implementation of effective safeguards would, as nuclear critic John Gofman argues in the film, lead to a "garrison state." Nor does he contend that commercial nuclear power should be stopped.

Also the show did not give an up-to-date evaluation of the current safeguards requirements, many of which were implemented and others proposed for implementation after and during the period when many of the interviews for this show were made. The safeguards against diversion are adequate, and will be made even stronger in the future - it is a dynamic system.

Another aspect of this program deserves comment. This program may have gone well beyond the point of warning to serious public disservice as referred to by John J. O'Conner in the March 9 issue of the New York Times; namely, "At what point does a detailed warning become a primer in the very subject it is supposedly warning against?"

40. *"The limits of error in accounting for plutonium are presently acknowledged to be about 1%, which means that about 2 tons of plutonium would be routinely unaccounted for annually."*

The limit of error in accounting for all forms of plutonium will vary according to the material form. In the first production-scale plants this limit is expected to be considerably lower than 1% for concentrated forms of plutonium suitable for the purpose of making an explosive weapon. By the same token, the limit is also expected to be larger than 1% for diluted forms of plutonium, as in waste, which would have absolutely no value for construction of weapons.

Regardless, this statement concerning materials accounting is taken completely out of context. The safeguards against theft of plutonium will be the security system. The materials accountability program will be used as part of the financial accounting system. There is little likelihood that this materials accountability program could ever track cumulative losses of gram-scale quantities of plutonium at an acceptable cost in a large processing plant. For that reason the security system must be designed as the defense against theft. At best, the accounting system will supply supplemental information as a backup to this security defense.

41. *"Even if a terrorist did not have the knowledge to fabricate a nuclear weapon, he could create havoc with stolen plutonium merely by threatening to release the material. Plutonium's extreme toxicity would present a severe hazard to any populated area in which it might be dispersed."*

Relative to the statement that a terrorist "could create havoc with stolen plutonium merely by threatening to release the material", such a person could threaten to release it even if he did not have it, or he could threaten to release many other substances more toxic than plutonium which are easier to obtain and safer to handle, and create havoc. This issue has been blown out of proportion. Professor Bernard Cohen of the University of Pittsburgh has done a detailed analysis of this issue while working at the Oak Ridge Institute for Energy Analysis.[32]

Cohen dismisses claims made by avowed opponents of nuclear power that an ounce of Pu-239, the fuel for breeder reactors, could kill 30 million people if dispersed in a city. The only way they could have obtained that number, Cohen said, is by assuming:

- that all plutonium released finds its way into a person's lungs and deposits there;
- that a person automatically dies if he is exposed to twice the "maximum permissible dose."

Using those same assumptions for the sulfur emitted from coal-fired power plants, Cohen discovered that a plant with the best pollution control equipment available would kill a million people per minute. "Clearly there is some error", Cohen added. The second assumption is wrong by a factor of 1000: exposure to twice the "maximum permissible dose" gives about one chance in 1000 of eventually dying of cancer. And if plutonium were dispersed in an area with urban population concentration, the first assumption is off by a factor of 50,000.

Other results of Cohen's study - based on reactor plutonium, a mixture of isotopes which he said is five times more hazardous than Pu-239 - include:

- "there would be about two deaths (from cancer 15 to 45 years later) for each ounce of this plutonium dispersed in a city without warning; if there is warning, so people breath through thickness of cloth, the toll would be ten times lower;
- it would take a dispersal of about two pounds of this plutonium to seriously contaminate an area the size of a football field;
- if this plutonium were dissolved in a city reservoir, there would be about one death for every ten pounds so dissolved."

Others have also been speaking out on this issue in an attempt to put it in perspective. Dixy Lee Ray, U. S. State Department, recently pointed out[41] that a teaspoonful of botulinus toxin would kill about 140 million people if taken orally. On the other hand, a teaspoonful of plutonium taken orally would be only about half enough to kill one person. Put another way, it would take 1.3 million-million more molecules of plutonium than botulism toxin to kill an average man if the dose was given intraveneously. It would take 1.1 billion more of such plutonium molecules than diptheria toxin molecules to achieve the same effect. Even 10 times more plutonium molecules than the toxin molecules in poisonous mushrooms would be necessary. In addition, such other toxins are far more difficult to remove from the atmosphere than is plutonium.

42. *"The recent explosion of two bombs at a nuclear plant site in France illustrates the likelihood of such activity." (i.e. the likelihood of theft or dispersal)*

The incident referred to here is in no way illustrative of the likelihood of theft or dispersal. No nuclear fuel was stored on the site.[72] Site security measures were generally consistent with the fact that special nuclear materials were not stored on site and there could be no concern about theft, diversion, or nuclear safety.

The incident occurred on May 3, 1975, on the site of a power station under construction at Fessenheim, France.[71] The bombs (which may have been placed by Ulrike Meinhof-Puig Antich Group) were concealed in a pile of equipment used in the construction of the station. The reports[71,72,73] indicate that although there was an explosion and fire, little damage resulted. Subsequent to the incident a barbed wired fence was erected around the site and a tight security system established.[73] The Ministry of Industry announced that additional security precautions had been taken at Fessenheim and other nuclear reactor construction sites in France.[72] And an official of Electricite de France, the utility that will operate the power station, stated shortly after the incident that "there is no comparison to be made between the safety measures now in effect and those that will be operative when the reactors are functioning."[71]

Accordingly, because site security for plants under construction is not representative of site security for operating plants, there is no basis for Mr. Nader's statement.

43. *"One tentative NRC proposal would establish a federal plutonium police force to deter and investigate theft of nuclear material. Even if this national police force could prevent any plutonium theft, which is doubtful, the question must be raised as to what threat such a force would present to individual civil liberties."*

There is no basis for assuming that the use of plutonium would infringe on the civil liberties of citizens, or as Mr. Nader has previously stated, "lead to a garrison state." Large quantities of plutonium and other nuclear materials have been inventoried and transported by the Armed Services without instance of theft. This custodianship, partly shared by the AEC, has not resulted in a garrison state in the U.S.

The world has entered a particularly disturbing period when violence and war are being increasingly used to influence the outcome of local and international disputes as well as for personal gain. Although the effectiveness of a nuclear weapon for purposes of threat or violence must be considered somewhat unique, such a weapon is only one of many schemes available to terrorists for achieving their objectives. Obviously, society has the obligation to protect its citizens against threats to life and property by the use of duly authorized security forces. For example, the security measures that have been implemented at commercial airports to prevent skyjacking have required some invasion of privacy, but have been highly effective in permitting the continued use of air transportation without significant risk to the public.

In a similar fashion, the implementation of nuclear safeguards for preventing illegal use of fissionable material will involve security investigations of nuclear facility employees in sensitive positions as well as the use of guard forces. These standard security measures have been used extensively in the past for purposes of national defense or for protection of proprietary information and valuable property in the commercial sector. Abuses of basically sound security measures have occurred in the past and effective precautions must be taken to prevent their recurrence in the future. The public sector affected by the safeguards system, primarily employees of the commercial nuclear industry, will be relatively small and should not be unduly inconvenienced by security precautions such that a threat to civil liberty is involved. To extrapolate the increased security measures that will be required for industry employees to a general loss of civil liberties for the general public is quite unfounded and illogical. The fissionable material required to satisfy the nation's energy needs will be available without incurring a significant risk to the public from theft or diversion.

44. *"...there are realistic alternatives such as conservation, solar, and geothermal in this time period."*

The "realism" of the geothermal alternative is emphasized by events surrounding the application by Pacific Gas and Electric for Unit 12 at the Geysers in California. More than three years have elapsed since filing for a permit to build this unit while the environmentalist allies of Nader have held up progress on its processing by one legal maneuver after another. Similar treatment is being given to developments in the Imperial Valley of California. Now these are the prime areas in the country where geothermal power has the best chance of making a small contribution to the energy needs of the state.

The element of geography is also ignored by those who would have us believe that geothermal energy can serve as a major energy source for the nation. The known geothermal provinces lie in the western third of the nation far from the industrial load centers in the midwest and east. The "realism" of the geothermal alternative falls on its face when faced with the task of transmitting electric power in the megawatt-mile quantities as indicated.

By 1985, the total electric capacity for the nation is expected to approximate 850,000 to 950,000 MW.[42] Thus the most optimistic expectation is that geothermal may supply just over 2% of the nation's generating capacity with 1/3% the more likely figure. Then there are the problems (environmental, economic and operational) which attend this source.

The inherently low efficiency of geothermal power plants exacerbates the environmental heat rejection problem. Subsidence of the surface above geothermal regions has no available solution and has contributed to the curtailment of New Zealand's geothermal program. All of these problems may or may not be soluble, but all the solutions will cost money which must ultimately be reflected in the consumers' bills.

Solar power is and will remain one of the most expensive methods of generating electricity. The best technology available today costs 2-3 times the cost of generation[43] by nuclear power or coal. The land area required for a solar plant is 35 times greater than that necessary for a nuclear plant and at least 70 times that required for a coal plant. The efficiency of these plants is lower still than that of the geothermal plants making the problem of heat rejection an even more expensive task and a still greater burden on the environment. The effect of a many-square-miles collector or reflector field on the micrometeorology of its locale has not even yet begun to be understood, much less solved, if indeed it can. The availability of solar power is a strong function of time-of-season, latitude and weather conditions. Supplemental backup power installations further increase operational integration and ultimate cost of solar energy. The task of maintaining the many square miles of collectors or reflectors would add still more to the cost burden.

There is no question that solar heating and cooling can make and will make contributions to space conditioning but its value will be primarily in partially replacing present fossil energy which is now devoted to that task. Glib assertions that solar will entirely replace fossil or electric power for these proposes are without merit.

Conservation is a much debated issue which will only be resolved by the passage of time. Our estimates of installed power capability in the future have taken into account conservation.

45. *"Even without plutonium the present generation of reactors has led to unauthorized surveillance of citizens. The Texas state police admitted that they compiled dossiers on nuclear power critics..."*

It is a fact that the Intelligence Service of the Texas Department of Public Safety carried out an investigation of Robert W. Pomeroy, founder of Citizens Association for Sound Energy. This was reported in the New York Times on August 5, 1974.[44] A copy of the investigation report was incorporated in the transcript of the Comanche Peak Environmental Hearing following page 94.[45]

According to the New York Times, the Department of Public Safety (DPS) investigation of opponents of nuclear energy began after reports were received from police agencies in other states that either actual or threatened damage to electric transmission lines may have been associated with persons on the fringe element of legitimate protest. The DPS reported that the Pomeroy file does not contain information of the type required by department policy, that the report[45] was destroyed, and that DPS at no time had reason to believe that Pomeroy was engaged in any illegal activity.

The New York Times reported further that the DPS advised the governor that the utility companies absolutely did not request the investigation of nuclear power opponents, and the Attorney General's Office said it would be difficult to prove that the investigations were illegal.

Westinghouse does not condone unauthorized investigation of citizens and even authorized investigation should be strictly limited. It is a fact of our times, however, that there are individuals and groups of extremists who do use violence to achieve their ends, some of which have included destruction of transmission lines. Such individuals and groups may and perhaps should be the subject of investigations when their activities affect or have the potential to affect society as a whole. That this is the case is well known and has nothing at all to do with nuclear power.

A case in point is that of Samuel H. Lovejoy as reported in the New York Times on March 2, 1974.[46] Mr. Lovejoy, concluding that a planned nuclear power installation in Montague, Massachusetts, was "no good," toppled a meteorological tower. In testimony before the Massachusetts Nuclear Safety Commission in Amherst, Massachusetts, on April 23, 1975, Mr. Lovejoy testified that the Montague station would be built over his dead body. We believe that if society decides that the plant should be built, extreme action on the part of Mr. Lovejoy or anyone else to prevent its construction could not be condoned. Given Mr. Lovejoy's testimony in Amherst and his admitted toppling of a tower to be used at least in part to obtain data to be employed in determining site suitability,we submit that he has taken an extreme position. It would not, therefore, be surprising or inappropriate under the circumstances for society to be concerned about Mr. Lovejoy's activities and want to keep an eye on him.

We believe the need to investigate citizens arises out of citizen actions and not because of activities in which our society chooses to engage. Should it be proposed that we eliminate airplanes, so we don't have to search people at airports, and eliminate courts, so we don't have to search people as they enter the courthouses, and so on?

46. *"The Virginia Electric and Power Company asked its state legislature to authorize the company to provide its own police force with the authority to arrest anyone anywhere in the State of Virginia and to gain access to confidential citizen records."*

The Virginia Electric and Power Company (VEPCO) asserts that it did feel the need to gain access to confidential citizen records for use in the conduct of investigations of the backgrounds of individuals being considered for employment at their nuclear plants. Initially, they were advised by the state police that such information could not be made available, and by the AEC that legislation authorizing access to such information would be required.

Enabling legislation[47] was drafted at VEPCO's request and furnished to the General Assembly of Virginia on January 16, 1975, for consideration, and subsequently amended[48] on January 31, 1975. Although VEPCO was only interested in gaining access to information for use in the conduct of background investigations, the bill as originally submitted was a copy of or similar to bills covering railroads and truckers that had been in existence for some time; these bills did include an arrest provision. Therefore, the proposed legislation to which Mr. Nader referred[47] also included such a provision only because the model bills did. The arrest provision was not included in the amendment.[48]

Subsequently, the state police did agree that it could properly make available the information requested by VEPCO, and the bill was withdrawn. This fact has not been acknowledged by Mr. Nader.

Westinghouse believes that it is prudent that appropriate investigations be carried out of the backgrounds of individuals being considered for employment in any activities which could impact directly on national security or public health and safety. Events have established that there was no need for the legislation submitted to the General Assembly. Without commenting on the appropriateness of the legislation, Westinghouse believes that VEPCO's need to gain access to background information is appropriate and legitimate.

47. *"After uranium pellets were found outside the Kerr-McGee fuel fabrication plant in Oklahoma and one of the persons raising questions about health and safety practices at the plant was killed in an auto crash under suspicious circumstances, Kerr-McGee asked its employees to 'volunteer' to take lie detector tests".*

The incidents in question at Kerr-McGee have been well documented by regulatory authorities and in other press releases.[49] The issue concerning claims of the labor union about health and safety practices is summarized below:

> "Inspectors from the AEC Regulatory Operations Offices investigated 39 items reported by the Union members dealing with four areas of concern. Only two of those items, and a third which was not among the allegations, were found to be in apparent noncompliance with AEC requirements. Eighteen others among the 39 items were found to have some substance and were called to the attention of Kerr-McGee.
>
> The three items of apparent noncompliance -- failure of the company to report to the AEC about a processing equipment problem; exceeding on two occasions the amount of plutonium permitted in a specific work area; and use by the licensee in a work area of a small quantity of plutonium in a form different from that authorized by the license -- did not pose a hazard to workers or the public. Enforcement action will be taken by the AEC against Kerr-McGee concerning those items of apparent noncompliance."

The "suspicious" circumstances claimed in the death of an employee were refuted by the following statement:[50]

> "Meanwhile, Oklahoma state health officer A. J. Chapman has completed his investigation into the death of Karen G. Silkwood, a Kerr-McGee plutonium facility employee who was killed in an automobile accident last month, and says that in his opinion, 'We're finished with it.' Chapman found 'more than a therapeutic dose' of a sleeping drug in Silkwood's body, and he maintains that that was the ultimate cause of the accident."

The significant point is that at no time during any of these exhaustive investigations was any injury to any employee uncovered which was attributed to plutonium.

Security checks at the Kerr-McGee plant can hardly be classed as "abuses" as claimed since all testing was done voluntarily on the part of the employees.[51] In fact, almost every employee agreed to take the test. Test results have not been published, but no incidents of unexplained materials dispersion have been reported since completion of the testing.

48. *"How is it possible to develop adequate safeguards without unacceptable degradations of civil liberties?"*

The best teacher is usually experience. In this instance,experience of over 30 years with the nuclear weapons and nuclear navy propulsion programs demonstrates quite clearly that such security programs can be conducted without abusing or degrading civil liberties. Governmental security clearance systems of the general types used for those programs may serve the commercial nuclear industry just as well.

In our society money is also guarded in periods of transit, as are sensitive government papers and documents. Each of these cases shows that valuable material can be moved without any inconvenience, much less interference of civil rights, to members of the public.

A rhetorical question can also be posed, re: the civil rights of individuals being infringed or protected when laws mandate an electronic search upon entering an airport. Society has accepted this inconvenience hoping to bring about a physical safety and security to those individuals searched. The handling and transportation of plutonium should pose no comparable annoyance to any individual, and certainly would in no way degrade the civil liberties of the general public.

49. *"Stopping the plutonium breeder is a major cancer prevention program".*

Many materials in our atmosphere today have been related to incidence of cancer in the human body. Not least among these are the tars and nicotine in cigarettes and sulfur and nitrogen compounds in stack emissions from fossil-fired power plants. Nuclear power promises a cleaner environment for cancer control rather than a worsening of the condition.

In terms understandable to all, the cancer-causing inhalation dose for cigarettes is reached after smoking 1 pack per day for 30 years.[32] The cancer-causing dose level for inhalation of reactor-grade plutonium at the <u>maximum</u> level set for exposure of the public would not be reached until you inhaled for over 20,000 years.

The important factor, however, in this instance is the impact that the total nuclear industry or the breeder industry will have on national health overall. In comparing the human "impact" of a nuclear versus non-nuclear electric generating industry, the assumption is made that coal will be the dominant energy source in the event of a nuclear moratorium. The accompanying table lists some of the human consequences associated with a nuclear industry, including introduction of the breeder in the early 1990s, and with a non-nuclear, coal-dominated industry. Coal usage, as an alternative to nuclear fuel, would bring about an additional 51,000 fatalities due to occupational accidents, 27,000 public fatalities due to transportation accidents, and 30,000 extra cases of coal workers pneumoconiosis. In this study, cancer effects related to emissions from fossil-fueled power plants were completely ignored, even though the counterpart data were estimated conservatively and included for the nuclear industry.

The increase of 50 malignancies to the public over 46 years for the nuclear case is so small as to be non-detectable among the tens of thousands of naturally occurring malignancies. Although the increase of 4000 occupational-related malignancies has been estimated, this number does not compare in magnitude to the number of deaths expected from a coal-dominated industry, nor do the 4000 malignancies amount to a sizable fraction of total malignancies occurring during these years.

Human "Impacts" in Total Power Industry[52]
(Cumulative from 1974 to 2020)

	With a Developed Nuclear & Breeder Industry	With No New Nuclear Plants After 1974
Occupational Fatalities	27,000	78,000
Public Fatalities in Fuel Transportation	13,000	40,000
Coal Workers Pneumoconiosis	14,000	44,000
Occupational Malignancies	4,300	670
Public Malignancies	56	6

50. *"The nuclear establishment has no more developed a disposal solution for breeder waste than it has for LWR waste. The present solution discussed by ERDA, which are only proposals on paper, amount to no more than guardianship of the waste. In the best case, guardianship will be required for 1000 years; in the worst case, for a quarter-million years. These time periods will challenge not only the stability of human institutions, but the stability of geological formations as well."*

This issue is discussed on pages 23, 24 and 52. Further, there appears to be no reason why wastes cannot be stored in geological formations that have been stable and free of water for hundreds of millions of years, and should remain stable for millions more with essentially no chance of water entering.[53] These time periods, though long, will not challenge the stability of human institutions, because if the human institutions do not last, we will have little or no worry about the waste problems. And if we do not have the long-term option of available economical nuclear electricity provided by the breeder, we risk economic disaster and major social and political revolution.

Professor Bernard Cohen of the University of Pittsburgh and the Oak Ridge Institute for Energy Analysis has performed an analysis of the long-term risks of deep salt mine disposal of radioactive wastes.[54] He has concluded that if this waste is buried, less than one life would be lost for each year the U.S. obtains all its power from nuclear reactors. This assumes no monitoring of the buried waste. Professor Cohen states that "Very careful watching of hundreds of years of waste accumulation would be a part-time job for one person."

51. *"The Natural Resources Defense Council, which also testifies today, has made a convincing case that the breeder reactor program is simply not economically viable, is not necessary, and that a decision to go forward with it can be delayed for a decade without foreclosing our energy options."*

Under all but the most extreme circumstances, the economic benefits of the LMFBR are obvious. The benefits of the breeder, measured in terms of savings to the nation's power customers, will be large. Introduction of power generating stations by the 1990s will save the nation billions of dollars. Besides power cost savings, the LMFBR will aid the U.S. balance of payments situation by decreasing the demand for imported energy resources. The brief history of nuclear power demonstrates the economic benefits and the return available from a relatively small R&D investment. The cost of developing the LWR over a 20-year period totals less than $2.5 billion. Yet this investment has nurtured an industry, still in its infancy, with current capital commitments of nearly $100 billion and fuel commitments estimated at $200 billion. The LMFBR investment can be expected to perform similarly.

The most recent and by far the most thorough and realistic economic analysis of the LMFBR is "An Assessment of the Economic Incentive for the Liquid Metal Fast Breeder Reactor " by T. R. Stauffer (Harvard University), H. L. Wyckoff (Commonwealth Edison Company), and R. S. Palmer (General Electric Company). In this assessment, the economic benefits of the breeder to the nation are determined by estimating the long-term cost of electric energy if the breeder is not available and comparing this to the cost if the breeder is available. These costs are measured in terms of basic national resources, labor, and materials, with transfer payments such as income taxes and financing charges excluded.

For the base case, the benefit of the breeder to the nation is $2.4 trillion (excluding inflation), which is $76 billion when present-value discounted to 1975.

If the estimated total LMFBR development costs of $10.6 billion are present-value discounted to 1975, they become about $6 billion. Thus, the projected economic benefits to the U.S. are more than 12 times the cost. Although a cost/benefit analysis cannot be the only criteria for proceeding with a program involving major investment, we do feel that the estimated benefits contribute heavily to the need to continue the LMFBR development on as rapid a schedule as possible.

52. *"Their (The Natural Resource Defense Council) position that development of the plutonium breeder decision could be delayed was recently confirmed by the EPA's comments on the breeder program's environmental impact statement."*

In reality the EPA was questioning the use of a fixed schedule for commercialization. A report on the EPA comments stated that:

"An EPA spokesman said the agency was not advocating such a stretchout of the breeder program but was suggesting that ERDA might do well to re-examine the timing. EPA also said the development portions of the breeder program (which would specifically include the Clinch River Demonstration Reactor Plant) 'can probably be conducted without any unacceptable adverse impacts on the environment' and that it has not uncovered any evidence 'of unresolvable environmental problems which might preclude LMFBR commercialization.'"[55]

53. *"EPA found that the AEC had apparently overstated the growth of electric power demand in the years 1970-2020."*

The EPA did not "find" anything. Projecting energy-electricity for the next 50 years is not an exact science. In reality, the EPA used the 1985 energy consumption projections of Project Independence for \$7.00/bbl and \$11.00/bbl oil[56] and then simply used the 2.6% growth rate in one of the Project Independence scenarios for the interval 1985 to 2020.[57] The result was a range in predicted annual energy demand of 240 to 260 x 10^{15} BTU for the year 2020 and, by assuming 65% of the energy input is generating electricity, electrical generation of 18.8 to 20.3 x 10^{12} kwhrs..

These potentialities are included in the AEC's cost/benefit analysis which considers a range of annual energy demands from 180 to 431 x 10^{15} BTU for the year 2020 and a corresponding range of electrical energy demand from 13.8 to 33 x 10^{12} kwhrs. Since fairly small changes in growth rate (2.5% for the EPA from 1985-2020 and 3.25% for the AEC from 1985-2020) can produce a sizable difference over a 30 to 40 year period, and considering the large uncertainties involved, there is really a fair agreement between the AEC and EPA projections.

54. *"The cost overruns that have afflicted the breeder program indicate that, if anything, present predictions on the total costs for the program are too small."*

The use of the words "cost overruns" is certainly not appropriate since inflationary effects causing increased escalation estimates and specific changes in scope of the program have accounted for most of the program cost increases.

We have no record of any comprehensive program cost estimate of \$2 billion in the mid-1960s.

The original total program cost estimate in 1968 was \$3.3 billion. Scope changes since the original estimate account for \$3.2 billion, and escalation since 1968 amounts to \$3.6 billion. Considering costs prior to 1969, the total present estimate, as given by Mr. Thomas Nemzek before the JCAE earlier this year, is \$10.6 billion.[59]

The \$10.6 billion estimate covers everything that is in any way connected with breeder development (research, development, construction, demonstration), including reactor physics and design; fuels and materials; reprocessing and fabrication of fuels; safety; component development; and plants such as EBR-II, FFTF, Clinch River, and design and subsidization of the Near Commercial Breeder Reactor plant. The \$10.6 billion estimate covers the period from 1950 through the end of this century.

Recent economic analyses by experts from Harvard University, Commonwealth Edison Company and General Electric[60] project present-value discounted benefits from the breeder to be more than 12 times the total discounted costs. These savings will be in reduced electricity rates to consumers.

Although \$10.6 billion is a large amount of money, it must be put in perspective. The breeder offers the greatest potential of the alternatives we have to guarantee future energy self-sufficiency in the U.S. This amount (\$10.6 billion) is less than what the U.S. paid for less than five months' worth of imported oil in 1974.

55. *"In June 1974, the General Accounting Office (GAO) estimated the cost of FFTF program at more than $933 million - over ten times original estimates."*

Such a statement is an oversimplification of the actual facts. In the Comptroller General's September 23, 1970 "Report to Congress" prepared by the General Accounting Office (GAO), the following comments are made:

1. The $87.5 million authorized by Congress in May 1966 was for design and construction only. An additional provision was that the legislation provided an additional 25%, giving a total authorized legislative limitation of $102.8 million on project costs prior to start of construction.

2. The above estimate specifically excluded other costs totaling $150.7 million, which included research and development expenses ($126.8 million), fuel loading ($10.5 million), and pre-operation start-up ($13.4 million).

3. The original estimate, according to the GAO, was seriously underestimated due to several factors. The technological base was not as advanced as originally believed. Further, qualified management and technical talent with necessary background and experience was not available in sufficient numbers. This in turn resulted in delaying completion of definitive conceptual design until early 1970. The net result according to the GAO was that "the first preliminary design work was initiated in January 1969. Most of the preliminary design work was not started until February 1970." Obviously, this delay dictates further readjustment to the reference baseline cost of $87.5 million utilized by Mr. Nader.

4. The GAO indicated that qualified vendors for the FFTF LMFBR fuels were not available and programs were underway to train them.

The June 1974 estimate of $933 million cost for the FFTF Project by the GAO was accurately quoted by Mr. Nader. However, he failed to point out that this includes not only the FFTF design and construction costs but research and development costs, plant spare equipment, plus a reserve for contingency and escalation. The costs attributable to FFTF design and construction only were budgeted at approximately $439 million in June

In summary, the most unfavorable comparison of an equivalent scope basis is not $87.5 vs. $933 million but rather $102.8 vs. $439 million. Even the latter comparison does not take into account adjustment for any of the factors cited by the September 23, 1970 Comptroller General's/GAO Report to Congress. Consumers, government and industry alike are all painfully aware of other detrimental cost factors in recent years -- inflation, shortages, strike impacts, material delivery delays, lengthening nuclear safety and licensing review cycles and environmental control -- to mention just a few.

The Joint Economic Committee of Congress is in the best non-partisan position to make a realistic comparison of 1966 vs. 1974 cost estimates for FFTF design and construction, taking into account all factors outlined above.

56. *"The first official cost estimate for the CRBR, in 1973, was $700 million. In July 1974, the CRBR cost estimates reached $1.7 billion dollars. The cost doubling time of the CRBR has been approximately one year, with the project completion date set for no sooner than 1982."*

Mr. Nader states correctly that the estimated cost of the CRBR program has increased from $700 million to $1.7 billion. He incorrectly states that the original estimate was made in 1973. It was made in 1972.

The more than $1 billion increase in total CRBR program estimated costs from 1972 to late 1974 are almost entirely due to factors beyond the control of those responsible for the program management.

Fully 60% of the increase ($600 million) is due to inflationary effects (2 year delay in the start of the program, 8% vs. 5.5% escalation rate, one year longer construction schedule, escalation computed on a larger base).

About 15% of the increase ($150 million) is in increased contingency allocation, and more than 20% of the increase ($220 million) results from design changes ($55 million) to make the plant more maintainable and for more stringent licensing requirements imposed since 1972 ($165 million).

Also,$70 million of the increase resulted from the transfer of certain R&D programs into project costs.

Also, it should be realized that all large, long term programs experienced significant cost increases during this period of rampant inflation. For example, the estimated cost of the Alaskan Pipeline increased from $900 million in 1969 to $6 billion in 1974, an increase of more than a factor of six.

57. *"Even ERDA's corrected estimates that the breeder program will 'only' cost $10 billion probably significantly understate the cost of the breeder program. ERDA's estimate understates the cost because they are based on unrealistic estimates of capital costs and because they do not include large hidden costs."*

No evidence exists for these statements. All capital cost estimates are as realistic as possible. Realistic escalation and contingency estimates are used throughout. The CRBR program cost estimate is an excellent example. There are no "large hidden costs". Mr. Nader refers to one point on subsidization of early breeder reactors. This is commented on next.

58. *"With respect to the hidden costs, ERDA estimates include only $300 million for subsidies that will have to be paid to the operators of the early breeder reactors. This subsidy will be necessary because the costs of the electricity produced by the early plutonium breeders will be much higher than the costs of electricity available from other sources. The April 28, 1975 GAO report revealed that the total subsidies could be as much as $2 billion."*

The program plans have been misunderstood. Beyond the CRBR, the program includes one Near Commercial Breeder Reactor (NCBR) Plant. ERDA and EPRI will jointly fund (about $20 million each) competitive designs of this plant. Plans are then that several Reactor Manufacturers and Architect-Engineers will submit commercial proposals to potential utility customers who will probably pay what they would otherwise pay for a light water reactor plant on a dollars/kilowatt basis. The non-economic portion might be covered by a direct subsidy, or it may be handled by providing low interest loans to cover the non-economic portion by reduced interest during construction. In the latter case, the government would be paid back.

In the former case, the $300 million would cover the non-economic subsidy. There are no plans for subsidized plants beyond the NCBR. Our studies indicate that with the economics of scale and design improvements presently identified, the next plant beyond the NCBR can be commercially competitive on a power generation cost basis. Since the fuel costs for the breeder will be much less than that for light water reactors, the plant capital cost of the breeder can be as much as $400/KWe higher*, and still have power generation costs equivalent to those for light water reactors.

*This reflects escalation at 6.5% to 1988.

59. *"With respect to the unrealistic capital cost estimates, ERDA assumes that the capital cost of the Near Commercial Breeder Reactor (built in the mid-1980s) 'could be as high as $1000 per installed kilowatt of capacity,' or approximately the cost for the LWR built in the 1980s after about 20 years of operating experience."*

Mr. Nader is correct in saying that the Near Commercial Breeder Reactor will cost about "$1000 per installed kilowatt of capacity." Westinghouse has made detailed estimates of the cost of the Near Commercial Breeder Reactor (NCBR).[61] These estimates have been based on the cost estimates for CRBRP together with our considerable knowledge of the cost of a light water reactor. Our conclusions were that, including escalation at 6.5% per year and interest during construction at 8.5% per year, the NCBR, for initial operation in 1985, would cost, in 1974 dollars, $1082/KW(e). Of this capital cost, $200/KW(e) will be offset by the LMFBR's favorable fuel cost relative to the light water reactors.

60. *"It is difficult to believe that the Near Commercial Breeder Reactor, the first reactor of its size, will cost no more than the light water reactors 1980's model. It is much more logical that the NCBR, a first breeder reactor of its size, will have capital costs that are much higher than the costs of the light water reactors built during the same time period."*

Mr. Nader <u>incorrectly</u> concludes that the cost of the NCBR (~$1000/KWe) will be the same as LWRs. This is due to the fact that he is not comparing capital cost estimates in same year dollars.

Using the same assumptions given in developing the response to the previous point (#59), the capital cost of the light water reactor, in 1974 dollars, for initial operation in 1985, was $688/KW(e). Thus the NCBR would have a capital cost approximately 50% higher than the LWR. However, with the fuel cost advantage (cited in point 59) equivalent to $200/KW(e), this would make the electric power generated by the NCBR about 25% higher than that for an LWR. When comparing these costs both in 1974 dollars, it follows that the NCBR will cost more than an LWR built during the same period.

61. *"These figures are an impressive statement of the last drawback of the breeder, which is its usurpation of research funds. The Ford Administration would devote $500 million to the breeder reactor for FY-76. This amount is fully 35% of the total civilian energy research and development budget for FY-76."*

Mr. Nader states that usurpation of research funds is a drawback of the breeder program. This issue was discussed on page 2, where it was pointed out that FY-76 funding requests for all alternate energy sources are up significantly from FY-75 (as much as 600% increase for solar).

Experts in ERDA have requested high priority funding for the breeder program because the breeder is: (1) already well on its way to commercialization (the technical and engineering feasibility is well established through 25 years of experience in designing, building and safely operating liquid metal cooled breeder-type reactors in the U.S.); and (2) the breeder has the greatest potential for supplying the large amounts of economically generated electricity that will be required to sustain a healthy economy with minimal unemployment during the period starting later this century when our domestic oil and natural gas resources approach depletion.

62. *"It is significant that the last of the AEC's official projections of future plutonium breeder expenditures, $8 billion to program completion, exceeds a recent Federal Power Commission estimate of the total R&D costs of developing all non-nuclear, and far safer, technologies, including coal gasification, solar (direct and indirect) and geothermal technologies, advanced steam cycles, MHD, fossil fuel affluent controls, and a variety of energy storage systems."*

Investigation revealed[62] that the Federal Power Commission (FPC) study referred to above is probably a September 13, 1973 draft of a "Report of the Task Force on Energy Conversion Research to the Technical Advisory Committee on Research and Development."[63] This is hardly a "recent" estimate. Regardless of the source of the estimate, it is important to distinguish between R&D program costs over the next decade and the total funding needed to make an energy development concept fully commercial. This danger of comparing "apples to oranges" is discussed in a later draft of the same FPC Task Force:[64]

> "The scopes of R&D covered by these total program costs vary with individual technologies; in some cases large demonstration plants are included in the costs and not in others, so that reference should be made to the reports on particular technologies where it is wished to make comparisons. The R&D costs are considered to include funding from all sources, Government and private, to the end points indicated, but as it was often difficult to ascertain planned R&D expenditures in the private sector, particularly by manufacturers, the R&D program costs shown are to be considered approximate only."

63. *"One would assume that a program that absorbed such a large segment of the energy R&D budget would have the nearly unanimous support of the scientific community. That is not the case. The Pugwash Conference of International Scientists on Science and World Affairs which questioned the further development of nuclear power, challenged further development of breeder reactors because they heighten the risks of nuclear power."*

The above statement does not represent a report of the complete Pugwash Conference, but has been based on the report of Working Group Five, which is the report of 21 scientists. The most eminent member of this group is H. Alfven,who is an expert in plasma physics with an avowed preference for fusion over fission. Even within this small group some members disagreed with the view that the breeder is not necessary[65]

The Pugwash Conferences are mostly aimed at the world military situation and the establishment of a lasting world peace. Most of the report of the continuing committee dealt with subjects such as limiting ABM deployment, reduced weapons delivery systems levels, reduced military R&D, reduction in nuclear proliferation, banning of incendiary weapons (such as napalm), bans on geophysical warfare, promotion of general and complete disarmanent, restricted arms sales to underdeveloped countries,and limits on environmental pollution. The report of the continuing committee for the <u>entire</u> conference does not take the total viewpoint of the Workshop Five. The continuing committee stated that:[66]

> "Pollution may result from large-scale power production by nuclear fission. In normal operation pollution from the power stations themselves is easily reduced to a very low level, and most of the possible pollution results from the disposal of nuclear waste extracted or evolved as gas in the reprocessing of fuel elements. The standards applied to direct dumping into the sea of diluted radioactive waste should be revised, keeping in view the possible accumulation of long-lived radionuclides.
>
> The present method of storing most of the radioactive residue resulting from the reprocessing of fuel elements, as concentrated highly active solutions in underground tanks, though quite safe in normal conditions, is not satisfactory, because of the possibility of the destruction of the tanks either through an accident or bombing in a conventional war. Other methods of long-term storage must be identified, tested and adopted as soon as possible, even if they are significantly more expensive.
>
> The possible consequences of a major accident in a nuclear power station, especially in the case of a fast breeder fueled with large quantities of plutonium, should be objectively studied by the IAEA or the proposed International Energy Institute."

64. *"Supporters of nuclear power have also doubted the wisdom of the present breeder program. W. Kenneth Davis, Bechtel Corporation executive, in his dissent to the Report of the Cornell Workshops on Major Issues of Our National Energy Research and Development Program stated,*

> *'The priorities and expenditures for the present LMFBR program need to be reexamined in light of competing needs, including such things as coal conversion R&D, and the probability of the present FBR program achieving a useful goal in the time required.'"*

Mr. Davis' comments have been taken out of context. His comments in context reflect his position that the breeder is needed, and the breeder development program should continue. He stated:[67]

> "The evident questions about uranium supply, even though I am an optimist about finding large reserves of uranium both in the United States and outside, dictate continuation of an effective breeder program with the possibility of commercial application on a time scale early enough to solve the raw materials problem if it actually develops."

65. *"Specifically, in regard to the Clinch River Breeder Reactor, for which ERDA is seeking $181 million in order to move it into a construction phase, the 10/22 draft of the Bethe panel of the Cornell Workshop stated, 'A reactor of such low performance is not a useful reactor at all.' Congress cannot responsibly appropriate huge sums for R&D programs on which the scientific community is deeply divided."*

The statement in the draft is based on a very pessimistic estimate for the performance characteristics of CRBRP fuel, which in turn was based on outdated or incomplete information. There was also a lack of understanding as to the purpose of CRBRP. These errors were corrected and the statement in the final copy concerning Demo I (CRBRP) was that:

> "Demo I is primarily intended as an operational demonstration and full-scale test of the engineering subsystems and nuclear core components (see Appendix B). For this reason, breeding performance of Demo I has been purposely compromised to provide maximum assurance of reliable operation. Demo I, therefore, is not representative of the ultimate performance of either a commercial plant or of a good breeder, although future core modifications may approach these objectives. Because of the urgency of our national objective, such modifications should be immediately planned and undertaken as soon as possible."[68]

As a prerequisite for commercialization, every new high technology concept, whether solar, geothermal, fission, or fusion, requires a demonstration plant to confirm performance characteristics -- operability, realiability and maintenance -- with industrially provided equipment developed beyond experimental versions. Without a breeder demonstration plant, industry and the financial community would lack the confidence required for commitments to commercialization.

66. *"As long as the energy research budget is so tilted to nuclear energy, nuclear power will be a self-fulfilling prophecy. The funds gobbled up by the breeder will forestall the development of safer, cleaner, renewable energy sources."*

Nuclear energy has highest priority in the energy research budget because it has the greatest potential for supplying the energy we will need in the future.

Today oil and natural gas provide almost 80% of our energy needs. By the end of this century our domestic oil and gas supplies may be approaching depletion. FEA has stated that depletion may occur before 1990.[69] Only increased utilization of coal and uranium can provide the energy we will need in the latter part of this century and beyond. And the breeder is needed to sustain the nuclear option of economical electrical energy.

It's an historically proven fact that energy is necessary to sustain a healthy economy and provide jobs. Energy and GNP have fluctuated together for the past half-century.

If we don't have adequate nuclear electricity as our oil and gas moves towards depletion, the result will surely be an energy shortfall and a depressed economy with massive unemployment. Nuclear power,and specifically the breeder,is today our top priority research effort because knowledgeable people understand what the consequences will be without it in the future.

In the long run,an economic recession or depression is an effective conservation measure, but by no means a desirable one.

67. *"Each of these sources (solar heating, geothermal, wind power, burning of garbage and conversion of waste to fuel) is in everyday use right now, in this country and abroad."*

This is an excellent example of generalizing from the particular. The "everyday use" is true, but it applies to such a miniscule amount compared to total energy use that without a modifier the claim is misleading. There is 500 MW of geothermal generating capacity compared to a total national capacity of over 500,000 MW.[70] Wind is used for a small amount of water pumping in various parts of the country, but the only electricity generated is with experimental units or for battery charging. There is no significant amount of electricity being generated by wind and none in commercial use.

To illustrate what would be required to obtain significant quantities of electricity from the wind, it would take a solid line of 500 foot high windmills running from the northern to the southern borders of the U.S. every 30 miles across the country from Atlantic to Pacific to generate 100,000 megawatts assuming 100% conversion of a constant wind blowing at a constant 20 miles per hour. Environmental effects and cost have not been evaluated but Sweden recently rejected a wind power program because a study there showed generating costs over three times greater than those for a nuclear plant.

Several plants provide power from refuse. One is at Lynn, Massachusetts, and provides steam to a nearby industrial plant. Another is operated by the Union Electric Company, Merrimac Station, in St. Louis. To use the refuse in the utility boiler, coal must be introduced with it to support combustion temperatures. The ratio is such that the refuse is less than a quarter of the input in BTU. The classification of refuse necessary before it can be used requires the expenditure of funds by the city and the value to Union Electric is insufficient to cover the cost. Hence a subsidy is necessary. Moreover, this is a demonstration project and does not represent a significant portion of Union's generation, let alone the state of Missouri or the nation.

The main point is that while all of the sources named can make a contribution to the country's energy needs and will likely increase their now miniscule value, they are insufficient in the aggregate to warrant abandoning all other efforts to secure energy sources and conversion apparatus for future needs.

68. *"The consequences of a renewable energy source accident would be infinitesimal beside the consequences of just one nuclear accident."*

It is not the relative magnitude alone of an energy source accident that must be considered, but also the probability of the accident and the consequences of not having that energy source.

First, nuclear power can provide us the energy we need to sustain a future healthy economy in the U.S., and as shown in the Rasmussen Report,the probability of serious accidents are infinitesimal compared to risks we take every day of our lives. The annual risk of death by an auto accident is 1 in 4,000; from a nuclear accident with 100 reactors operating, the risk of death is 1 in 300,000,000.[36] To date there have not been any fatalities from nuclear electrical generating plant accidents. What other existing energy producing industry can make that statement?

Secondly, all knowledgeable experts agree that the renewable energy sources cannot provide the energy we will need by the turn of the century. The consequences of forsaking the nuclear option and depending on renewable energy sources would result in disasterous energy shortfalls, a severely depressed economy and massive unemployment. The probability of this occuring is very high.

69. *"In summary, we have to judge the risks of the breeder by our experience with all other technologies. Other technologies, in spite of their promoter's claims, have suffered catastrophes.*

No dollar was spared in the space program, but the Apollo fire occurred.

The Titanic was supposed to be unsinkable. It sank."

Mr. Nader states that "we have to judge the risks of the breeder by our experience with all other technologies." Such general statements can be misleading. For example, Mr. Nader says, "The Titanic was supposed to be unsinkable. It sank." If an accident analysis such as performed by Professor Rasmussen had been performed on the Titanic, the ship would not have been judged to be unsinkable. Analysts would have identified accident sequences based on careful study of ocean liner accidents and would have postulated the Titanic response to maximum hypothetical accidents. The "unsinkable" characterization of the Titanic is strictly a laymen's term with no technical substantiation. Also, despite the Titanic disaster, ocean-going liners continued their voyages. A passager risk was accepted in light of the benefits.

70. *"We were constantly assured by industry and Federal regulators that the public was protected from unsafe drugs, but thousands of babies were deformed by thalidomide. Who can assure that it will not happen in nuclear power?"*

Obviously, no one can give 100% assurance that absolutely nothing will happen. Also, no one can assure 100% that if we adapt a zero energy growth policy that we won't have massive social unrest resulting from a depressed economy with associated very large unemployment, upset of our political system, or even international war to obtain the energy that we too late realized we needed through imports. No one can be absolutely sure what the effects of the massive use of coal will be. Indeed, over 100,000 people have died in coal mine accidents already this century.

No other industry has put so much emphasis on safety than has the nuclear industry. No other industry has faced up to the risks involved in its product and taken all steps necessary to reduce those risks to infinitesimal levels. No other industry in the U.S. today has the exemplary safety record of the commercial nuclear power industry.

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