

096940

~~76-0095~~

REPORT TO JOINT COMMITTEE
ON ATOMIC ENERGY
CONGRESS OF THE UNITED STATES

RELEASED



BY THE COMPTROLLER GENERAL
OF THE UNITED STATES



LM096940

Evaluation Of The
Administration's Proposal
For Government Assistance
To Private
Uranium Enrichment Groups

On June 26, 1975, the President proposed to the Congress legislation to allow the Energy Research and Development Administration to assist private firms to build, own, and operate commercial uranium enrichment facilities. A private group made a proposal for Government assistance to help build such an enrichment plant.

GAO recognizes Government assistance may be justified to help industry build commercial enrichment plants. However, GAO believes the private group's proposal should be rejected. Instead, GAO believes the Government should add on to one of its existing plants to provide the needed capacity.

RED-76-36

OCT 31 1975

702461
096940



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

B-159687

The Honorable John O. Pastore, Chairman
Joint Committee on Atomic Energy
Congress of the United States

Dear Mr. Chairman:

In response to your request, we are submitting this report on the proposed legislation to develop a competitive private uranium enrichment industry. A major part of the report deals with the proposal by private industry to build the next increment of enrichment capacity.

The Energy Research and Development Administration's comments along with our conclusions are included in the report.

We will contact your office in the near future to arrange for the release of this report so that copies can be provided to other congressional committees and to interested Members of Congress.

Sincerely yours,

A handwritten signature in cursive script that reads "James B. Stewart".

Comptroller General
of the United States

Table of contents

	<u>Page</u>
DIGEST	i
CHAPTER	
I INTRODUCTION	1
Uranium enrichment--what and where it is	2
Uranium enrichment technologies	4
Efforts to encourage private enrichers	6
Description of the proposed legislation	8
II ANALYSIS OF UEA'S PROPOSAL TO BUILD A GASEOUS DIFFUSION PLANT	10
Information on Uranium Enrichment Associates	10
Government assistance sought by UEA	14
Potential financial commitment by the Government	18
Assumption of risk	18
Other proposals	22
III FACTORS IMPACTING ON WHETHER INDUSTRY OR GOVERNMENT SHOULD PROVIDE THE NEXT INCREMENT OF ENRICHMENT CAPACITY	26
Reasonable price	26
Foreign implications	27
Safety and safeguards	28
Cash flow impact on the U.S. Treasury	31
Cost and timing of next enrichment capacity	32
IV ALTERNATIVE FORMS OF GOVERNMENT OWNERSHIP	36
Continued operation within ERDA with self-financing authority	36
Wholly owned Government corporation within ERDA	38
Wholly owned independent Government corporation	38
Government corporation with joint Government and private ownership	39
V CONCLUSIONS	41
Matters for consideration by the Joint Committee on Atomic Energy	46
VI SCOPE OF REVIEW	47

	<u>Page</u>
APPENDIX	
I FOREIGN ENRICHMENT CAPACITY	48
II COMPARISON OF CURRENT AND FORMER UEA PROPOSALS	50
III AGENCY COMMENTS AND GAO EVALUATION	52

ABBREVIATIONS

ERDA	Energy Research and Development Administration
GAO	General Accounting Office
SWU	Separative Work Unit
UEA	Uranium Enrichment Associates

COMPTROLLER GENERAL'S
REPORT TO THE JOINT
COMMITTEE ON ATOMIC
ENERGY

EVALUATION OF THE
ADMINISTRATION'S PROPOSAL
FOR GOVERNMENT ASSISTANCE
TO PRIVATE URANIUM
ENRICHMENT GROUPS

D I G E S T

Before uranium can be used in most nuclear powerplants to generate electricity, it must undergo a process called enrichment. All existing uranium enrichment facilities in the United States are owned by the Energy Research and Development Administration (ERDA). (See p. 2.)

If the use of nuclear power to generate electricity is to grow, then additional uranium enrichment capacity must be developed to meet the needs of U.S. and foreign customers. While the immediacy of the need cannot be stated with certainty, additional capacity is projected to be needed by the early 1980s. Because of the long lead time associated with the design and construction of enrichment facilities, prompt decisions regarding the amount, the type, and the manner of that capacity are needed. (See p. 3.)

The Administration has proposed legislation intended to facilitate both decisions and action. Its proposal is intended to encourage "privatization" of the enrichment process and it would:

- Authorize ERDA to enter into cooperative arrangements with as many private firms that wish to build, own, and operate enriching plants as the ERDA Administrator believes necessary to develop a competitive industry.
- Authorize ERDA to provide various forms of assistance and assurances under such arrangements.
- Limit the U.S. Government's total potential liability to \$8 billion in the event that the private ventures fail and the Government has to take them over.

--Authorize ERDA to start construction planning and design activities for expanding one of the Government's existing enrichment facilities as a contingency measure.

--Provide for congressional review of the basis for the cooperative arrangements by the Joint Committee on Atomic Energy. (See p. 8.)

ERDA and private firms interested in building enrichment plants say Federal assistance is necessary to overcome uncertainties associated with private firms providing enrichment capacity. These uncertainties are:

--Processes have not been shown to be operable in a commercial environment.

--Technology is classified.

--Large capital requirements and a long pay-back period are required.

--Licensing uncertainties exist.

--Threat of a nuclear moratorium exists.

--Many domestic electrical utilities are in weak financial condition. (See p. 7.)

A basic difference exists between a decision on providing the next increment and future increments of uranium enrichment capacity.

While it may be possible to provide the next increment using the newer gaseous centrifuge process, it is generally agreed that the proven gaseous diffusion technology should be used to provide the next increment so that the country will be more certain of an adequate supply of enriched uranium during a period of transition between diffusion and centrifuge technology.

Gaseous diffusion plants owned by the Government and operated under contract by private firms have been operating successfully for over 30 years. (See p. 4.)

The next increment of uranium enrichment capacity is likely to be the last-of-its-kind in the United States which uses gaseous diffusion technology. Future capacity most likely will use the gaseous centrifuge or other advanced enrichment processes because they offer potential advantages in such areas as total cost, energy use, flexibility, and simplicity.

The potential for technological obsolescence of the diffusion process--taken together with other uncertainties--makes it unlikely that any private firm would undertake the construction of a last-of-a-kind gaseous diffusion plant without considerable Government assurances and guarantees.

The Administration's proposal provides such guarantees in order to insure the "privatization" of the enrichment process.

The basic difference between the next and future increments of uranium enrichment capacity is underlined by the mixed response of private industry to the Administration proposal.

For the next increment using the proven gaseous diffusion technology, ERDA has received a single proposal from Uranium Enrichment Associates. (See p. 10.) Several proposals have been received with respect to subsequent increments utilizing the more advanced gaseous centrifuge technologies. (See p. 22.)

The limited response by industry with respect to the next increment of capacity and the nature of that response makes it essential that the option of the Government providing the next increment of capacity by adding onto its existing plant be carefully weighed against Government assurances necessary to get private industry to build such capacity.

Certain a priori arguments can be made in favor of "privatization" of the next increment of uranium enrichment capacity by accepting the proposal of Uranium Enrichment Associates. One's position on such arguments, however, is largely a function of one's belief

in the ability of the "market" to produce appropriate social results and one's view on whether a "market" actually exists. The single proposal for the next increment of uranium enrichment capacity in and of itself hardly constitutes a market.

GAO takes no position on the appropriateness of "privatization," i.e., whether it is "good" or "bad," GAO believes that the consequences of "privatization" for the next increment of capacity should be weighed against the consequences of alternative options. Certain basic questions need to be addressed:

--Which is the least cost?

--Which is most likely to succeed in providing needed capacity in a timely manner?

--Which is likely to allow for maximum flexibility in capacity in case assumptions or circumstances change?

Analysis of the options led GAO to conclude that the next increment of uranium enrichment capacity should be achieved by adding on to the existing Government gaseous diffusion plants because:

--The proposal of Uranium Enrichment Associates is not acceptable. Its fundamental short-coming is that it shifts most of the risks during construction and proving the plant can operate to the Government. In particular, the provision that gives the private group the option to turn the project over to the Government if long-term financing cannot be arranged, if the plant does not operate successfully during the first year, if its customers are not assured or under certain other conditions seems excessively generous. Also, contracts the private group will require customers to enter into before it accepts responsibility for the project essentially assures it a stated rate of return. (See p. 18.)

--A decision is needed now, at least on the next increment of uranium enrichment capacity, if it is to come on-line in the

early 1980s when needed. Because of the technological obsolescence factors associated with the next increment being the last-of-its-kind facility, there is doubt as to whether the private group will accept much less in the way of Government assurances and guarantees than those included in its existing proposal.

--There is a greater potential for slippage in the private group's schedule for bringing additional capacity on-line. On balance, GAO believes that problems which could occur in (1) licensing of the new facility, (2) obtaining of electric power to run the facility and the related licensing of any require nuclear powerplants, and (3) obtaining the required capital investment, outweigh any similar problems which would be faced in adding capacity to existing Government plants. (See p. 32.)

--Additions to existing plants can be done at an estimated construction cost of \$2.1 billion as compared to the estimated cost of the private group constructing a stand-alone plant of \$2.7 billion. (See p. 32.)

--An add-on can be phased in increments thereby keeping additional gaseous diffusion capacity at the minimum consistent with the development of centrifuge technology, and maximizing flexibility to deal with problems of changing demands or poor projections. (See p. 4.)

--Management of the Government enrichment facilities could be accomplished more effectively by a corporation having a self-financing authority to borrow funds from the Treasury or the public. A self-financing proposal would free the corporation from the budgetary requirements to seek congressional approval of appropriations, thereby achieving a major goal sought by the present legislative proposal. (See p. 36.)

GAO deliberately separated the issue of the next increment from the questions surrounding additional future capacity. While the issues are presented in the Administration's legislative proposal as a package, they are clearly separable.

GAO's analysis yielded no areas in which a decision not to proceed with "privatization" of the next increment would preclude actions to encourage a competitive private industry for future capacity using gaseous centrifuge and other advanced technologies. GAO believes the greater industry interest in centrifuge operations is an encouraging sign.

Research and development efforts in advanced enrichment technologies such as gas centrifuge and laser isotope separation offer potential for more efficient enrichment of uranium. Gas centrifuge also offers the potential for involvement of more private firms because it can be built in smaller increments which require less capital. Even using advanced technologies, however, competition will be limited.

Nevertheless, GAO believes that ERDA should seek and encourage private industry to continue efforts in advanced technologies through explicit programs. GAO recognizes that Government assistance and assurances will be required. In working to this end, however, the Government should seek a more equitable sharing of risk by the private enrichers and the Government.

The Administrator of ERDA generally disagreed with the analysis, presentation, and conclusions of this report. (See p. 52.)

MATTERS FOR CONSIDERATION BY THE
JOINT COMMITTEE ON ATOMIC ENERGY

The Joint Committee on Atomic Energy should consider:

- Authorizing ERDA to construct the next increment of the enrichment capacity using the proven enrichment process.
- Establishing a Government corporation with self-financing authority to manage the Government's uranium enrichment facilities.
- Developing legislation with provisions similar to those in the Administration's

legislative proposal authorizing ERDA to enter into cooperative agreements with private enrichers using advanced technologies.

BEST COPY AVAILABLE

CHAPTER 1

INTRODUCTION

The Federal Government through its Energy Research and Development Administration¹ (ERDA) owns all existing uranium enrichment capacity in the United States. Additional capacity must be built if enriched uranium is to be available to fuel nuclear power reactors which come on line early in the 1980s. Because at least 8 years will be required to build additional capacity, decisions regarding its development must be made soon.

Since 1971 the executive branch has followed policies and programs designed to encourage private industry development of uranium enrichment. In June 1975 the President proposed to the Congress legislation called the Nuclear Fuel Assurance Act of 1975 (S. 2035) that would enable ERDA to negotiate and enter into cooperative arrangements with private organizations that wish to build, own, and operate uranium enrichment plants. The legislation is intended to (1) provide needed enrichment capacity and (2) create a competitive uranium enrichment industry.

The Chairman of the Joint Committee on Atomic Energy asked us to review the legislative proposal and a related proposal made to ERDA by a private firm. That firm proposes to build the next increment of uranium enrichment capacity subject to receiving a number of Government assurances. This report summarizes the results of our review.

Several basic questions must be considered in any evaluation of the factors bearing on development of additional uranium enrichment capacity.

--Since the Government could feasibly add on to its existing uranium enrichment capacity, what are the advantages and disadvantages of having private industry involvement in terms of cost, competition, and other factors?

¹The Energy Reorganization Act of 1974 (Public Law 93-438) abolished the Atomic Energy Commission and established the Energy Research and Development Administration and the Nuclear Regulatory Commission on January 19, 1975. All Atomic Energy Commission programs and activities discussed in this report are now carried out by the Energy Research and Development Administration and the Nuclear Regulatory Commission.

--Should the next increment of uranium enrichment capacity use the technology proven successful in Government plants? Should other promising, but untried, technologies be expedited?

--What type of competitive environment would exist for a private uranium enrichment firm operating under the proposal now before ERDA?

--What Government guarantees will be made to get private enterprise involved in uranium enrichment?

The following chapters of this report contain information on each of these questions.

URANIUM ENRICHMENT--WHAT AND WHERE IT IS

Uranium enrichment involves separating the two principal isotopes of uranium found in nature--uranium 235 and uranium 238. Uranium in its natural state contains 0.711 weight percent uranium 235. The work done to separate these isotopes (or enriching the uranium 235 component) is called separative work, and the product achieved is called enriched uranium. The production capacity of enrichment plants is in terms of "separative work units." A separative work unit (SWU) is not a quantity of material but is a measure of the effort expended to separate a given quantity of uranium feed into two streams, one having a higher percentage of uranium 235.

Most domestic and foreign commercial nuclear power reactors use slightly enriched uranium--between 2 and 4 percent by weight uranium 235--as fuel. Uranium products of higher enrichment--5 to 97 percent by weight uranium 235--are used for weapons purposes and for fuel in high-temperature gas-cooled reactors and in specialized reactors.

Uranium enrichment facilities in the United States consist of plants located at Oak Ridge, Tennessee; near Paducah, Kentucky; and near Portsmouth, Ohio. These plants are owned by the Government and are operated by private firms under cost-plus-fixed-fee management contracts. Union Carbide Corporation nuclear division operates the Oak Ridge and Paducah plants and Goodyear Atomic Corporation operates the Portsmouth plant.

ERDA's three enrichment plants are the major source for enriching uranium in the world. Other nations and consortiums are operating and are planning to construct enrichment plants. These foreign initiatives appear to have accelerated in the last years in which there has not been any new U.S. capacity.

Information on the current status of existing, planned, and potential enrichment plants outside the United States is contained in appendix I.

ERDA supplies enrichment services to both domestic and foreign customers under three major types of contracts: (1) requirements contracts, under which ERDA agrees to supply all of the enriched uranium required to fuel a specific nuclear reactor, (2) long-term, fixed-commitment contracts, under which ERDA agrees to provide fixed amounts of enriched uranium for a certain time period, and (3) conditional contracts, under which ERDA agrees to provide enriched uranium if certain enriching capacity currently under contract is freed. The table below shows the distribution of contracts as of August 30, 1975, among the three types of foreign and domestic customers.

<u>Type of contract</u>	<u>Domestic</u>	<u>Foreign</u>	<u>Total</u>
	----- (thousands of megawatts) -----		
Requirements	77	26	103
Long-term, fixed commitment	<u>131</u> <u>208</u>	<u>81</u> <u>107</u>	<u>212</u> <u>315</u>
Conditional	<u>-</u>	<u>14</u> ^a	<u>14</u>
Total	<u>208</u>	<u>121</u>	<u>329</u>

^aOn August 6, 1974, the President assured foreign countries that the United States would, in any event, fulfill the fuel requirements of the conditional contracts.

The total commitment for enrichment services shown above represents ERDA's total enrichment capacity. Consequently, for the continued growth of nuclear power beyond early in the 1980s, provisions must be made for additional enrichment capacity.

While the exact number and timing of additional enrichment plants will vary with the assumptions made regarding such things as the rate of nuclear power growth, any growth in nuclear power will require new enrichment capacity. Considering the leadtime required to either build new capacity or add on to existing plants (about 8 years), a decision to provide for this capacity must be made soon. ERDA says that the next increment of enrichment capacity will be needed in about 1983.

Various ERDA actions are possible which could delay the time when additional capacity is needed, including (1) increasing current enrichment output in ERDA's plants by adjusting the operating characteristics (in enrichment jargon raising the plants' tail level) which would require more uranium feed, (2) cancelling ERDA's enrichment contracts with foreign customers, and (3) using more of the existing ERDA enriched-uranium stockpile to meet customer needs. ERDA believes that each of these actions would be drastic and unreasonable.

URANIUM ENRICHMENT TECHNOLOGIES

Enrichment technologies that are or may be available to Government and industry are gaseous diffusion, gas centrifuge, and laser isotope separation.

Gaseous diffusion

The gaseous diffusion process depends on the small difference in mobility between the molecules of gaseous uranium 235 and uranium 238 hexafluoride. When contained within walls composed of a porous barrier (or membrane), the lighter uranium 235 molecules pass through the barrier more readily resulting in a stream that is slightly enriched in uranium 235. However, the degree of enrichment which can be achieved in a single diffusion through the porous barrier is very small. Thus, the diffusion process must be repeated a large number of times.

Because of the repetitive nature of the process, these plants are among the largest industrial facilities in the world. Process buildings at the three Government sites have a gross floor area of approximately 28 million square feet, or 1 square mile. A gaseous diffusion plant of about 9 million SWU requires about 2,500 megawatts of electricity--equivalent to roughly two dedicated electrical powerplants. This large power requirement is the major disadvantage of the process.

The Government's gaseous diffusion plants now have a total capacity of about 17 million SWU. An expansion program now underway will increase total capacity to about 27 million SWU. The plants can be expanded further in relatively small increments without economic penalty. A new plant, on the other hand, requires a minimum size of about nine million SWU to operate economically.

Most ERDA and industry officials agree that because this technology has been working successfully (a 99.5-percent reliability rate for 30 years), it should be used for the next increment of capacity.

Gas centrifuge

Like gaseous diffusion, gas centrifuge process theory is based on the small differences in molecular weight between uranium 235 and uranium 238. This process was suggested for isotope separation as early as 1919, but mechanical problems prevented any measurable progress in this field until 1934. Since then a great deal of work has been done around the world to study and improve the centrifuge process.

Since 1960 ERDA has been carrying out an expanded research and development program to demonstrate the gas centrifuge process. The research and development on the centrifuge process has advanced to the point where an enrichment plant using the process can be built. The main question remaining is one of economics; whether the centrifuge process can operate at a cost as low as or lower than the gaseous diffusion process.

ERDA has constructed a pilot centrifuge plant, and startup is expected early in 1976. The pilot plant will proof test the design and operation of the entire production process system. It will provide plant design, construction, startup, and operating experience to aid in the process and equipment selection for new enrichment capacity. Such plant experience is needed for the centrifuge process. ERDA is also initiating conceptual engineering studies on production-size plants.

The chief advantage of the centrifuge process is that its electrical demands may be less than 10 percent of those of the gaseous diffusion process. However, uncertainties exist as to the rate of machine replacement and repair costs. Due to the ultrahigh speed at which the machine operates, centrifuge repairs may be relatively more frequent and more expensive than for conventional rotating machinery.

A centrifuge plant is expected to have the same capital cost per SWU as a diffusion plant. But since centrifuge plants of 3 million or more SWU capacity are expected to be economical, capital required for each plant will be about one-third that required for a diffusion plant. Because of this characteristic, ERDA expects that more private firms could enter the enrichment industry, thereby increasing the potential for a competitive industry.

ERDA and private firms generally agree that this process is promising and will work but, because it has not been successfully demonstrated, should not be relied upon for the next increment of capacity.

Laser isotope separation

Two ERDA laboratories are doing research and development work on using lasers to enrich uranium. This process, called laser isotope separation, is still in the research stage. If successfully developed, the process could impact considerably on the economics of enriching uranium. The ERDA laboratories have made preliminary estimates that the capital cost of a laser isotope separation plant would be about \$90 million. ERDA headquarters officials stated, however, that the process has not yet been determined to be technically or economically feasible, thus production plant extrapolation at this time are meaningless.

Estimates of the annual electric power required for a laser plant range from 8 to 100 megawatts.

If successfully developed, the process is expected to be able to enrich uranium more efficiently than the gaseous diffusion and gas centrifuge processes.

EFFORTS TO ENCOURAGE PRIVATE ENRICHERS

The Atomic Energy Act of 1954 (Public Law 83-703, as amended) and the Private Ownership of Special Nuclear Materials Act of 1964 (Public Law 88-489, as amended) require ERDA to encourage civilian nuclear power industry development. The industry has developed capabilities to provide all the materials, equipment, and services needed in generating nuclear power, except uranium enrichment.

Since 1971 the executive branch has followed policies and programs to encourage private industry--rather than the Federal Government--to build the next increments of uranium enrichment capacity. To help private industry enter this market, a classified information access program was initiated. In this program, two types of permits allow access to classified information on isotope separation. Subcategory A permits allow an initial level of access by making available to qualified companies information in summary form concerning the status and potential of the gaseous diffusion and gas centrifuge processes. The following organizations hold subcategory A permits: Atlantic Richfield Company; Houston Lighting and Power Company; Texas Utilities Services, Inc.; Tennessee Valley Authority; TRW, Inc.; Consumers Power Company; General Electric Company; and Sundstrand Corporation.

Subcategory B permits are for a higher level of access. These permits grant access to more detailed information on any aspect of isotope separation by the gaseous diffusion or gas centrifuge processes including information on the

design, construction, and operation of any plant, facility, or device capable of separating isotopes by either method. Subcategory B permits have been issued to Uranium Enrichment Associates; Electro-Nucleonics, Inc.; Exxon Nuclear Company, Inc.; Goodyear Aerospace Corporation (a subsidiary of Goodyear Tire and Rubber Company); United Technologies Corporation; General Atomic Company; Boeing Company; and Garrett Corporation.

To date four private organizations have expressed interest in building uranium enrichment plants. Uranium Enrichment Associates (UEA)--currently consisting of Bechtel Corporation and Goodyear Tire and Rubber Company--are interested in building a gaseous diffusion plant. Three groups are interested in building gas centrifuge plants--Garrett Corporation; Exxon Nuclear Company, Inc.; and CENTAR (Electro-Nucleonics, Inc. and Atlantic Richland Company). Regardless of the technology employed, an enrichment facility requires a large amount of capital to construct and to operate and would not generate profits for a considerable number of years. Therefore, substantial debt financing will be necessary. To attract the capital, all four organizations and ERDA have determined that some form of Government cooperation and assurances is needed in view of major uncertainties associated with private industry providing enrichment capacity. The uncertainties include:

- The processes have never before been used in a commercial environment.
- The technology is classified.
- Large capital requirements and long payback periods are required.
- Licensing uncertainties exist.
- There is a concern over the possibility of a nuclear moratorium.
- Many domestic electrical utilities have weak financial conditions.

On June 26, 1975, the President proposed to Congress legislation called the Nuclear Fuel Assurance Act of 1975 that would enable ERDA to negotiate and enter into cooperative arrangements with private organizations that wish to build, own, and operate plants for enriching uranium. The legislation is intended to (1) provide needed enrichment capacity and (2) create a competitive uranium enrichment industry.

Cooperative arrangements would be spelled out in detailed contracts between ERDA and the private participants, and the basis for such arrangements would be subject to congressional review. These arrangements would give various forms of assurances to private firms wanting to build enrichment plants. ERDA sees supporting several such plants for a transition period until they operate successfully. At that point the Government would step out and, according to ERDA officials, leave a strong and competitive industry.

ERDA sees the next increment of enrichment capacity using the gaseous diffusion process and future increments using the centrifuge and/or laser isotope separation technologies.

DESCRIPTION OF THE PROPOSED LEGISLATION

The proposed legislation would permit ERDA to enter into cooperative arrangements with as many firms as the ERDA Administrator believes necessary to develop a competitive private enrichment industry.

The Government, through ERDA, would be authorized to provide various forms of assistance and assurance to private enterprises entering into the arrangements. Form and degree of assistance and assurance would be at the discretion of the ERDA Administrator. The proposed legislation includes, but is not limited to, such assistance and assurances as:

- Furnishing technical assistance, information, inventions and discoveries, enriching services, materials, and equipment on the basis of recovery of costs. The Government would also receive royalties.
- Guaranteeing the quality of Government-furnished equipment and materials.
- Assuring that the facility will perform successfully.
- Purchasing SWU from the private enrichment plant.
- Buying the assets or interests of any U.S. citizen or organization owned or effectively controlled by U.S. citizens in any enrichment plant, and assuming their obligations and liabilities, if private industry cannot finish or bring the plant into commercial operation.
- Modifying, completing, and operating the plant as a Government facility or disposing of the plant.

The proposed legislation also would authorize ERDA to enter into an unlimited number of contracts with private firms. However, the proposed legislation imposes an \$8 billion limit on the total potential cost to the Government in the event all private ventures covered by cooperative arrangements were to fail and the Government was required to assume assets and liabilities of the ventures, to take over the plant, and to compensate domestic investors. Because of its technical participation in the project, ERDA does not expect that any of these funds would be expended but believes that the legislation is necessary to assure customers and the financial community of the Federal Government's commitment.

Congressional review, by the Joint Committee on Atomic Energy, is also provided for in the proposed legislation. Before the ERDA Administrator enters into any arrangement, changes any agreed on arrangement with private industry to develop a uranium enrichment facility, or decides to modify or complete and operate or dispose of any private enrichment facility, he must forward the basis for such arrangement or amendment to the Joint Committee. The Joint Committee will have 45 days (excluding the days when either house is not in session because of adjournment for more than 3 days) to review the basis for the arrangement unless it waives this right.

The proposed legislation would also authorize ERDA to start construction planning and design activities for expanding one of the Government's existing enrichment facilities. This would be done as a contingency measure to insure that national enrichment capacity will be available in case the private industry ventures fail. As of October 1, 1975, ERDA had spent about \$4.1 million on conceptual design for the Government add-on plant. If the contingency activities are still underway for the ensuing 12 months, ERDA expects it will obligate about \$40 million.

- - - - -

In a letter dated October 14, 1975, the Administrator of ERDA commented on a draft of this report. Generally, he disagreed with our analysis, presentation, and conclusions. The text of the Administrator's letter along with our evaluation is contained in appendix III.

CHAPTER 2

ANALYSIS OF UEA'S PROPOSAL TO BUILD A GASEOUS DIFFUSION PLANT

On May 30, 1975, UEA submitted a proposal to ERDA to build a gaseous diffusion plant provided that ERDA gives UEA certain forms of assistance and assurances. On July 8, 1975, ERDA entered into negotiations with UEA to develop a cooperative arrangement in anticipation of passage of the legislation. Our discussion and analysis of the UEA proposal are based on the May 30 proposal and information provided by ERDA officials concerning the ERDA-UEA negotiations that, according to ERDA officials, were still underway as of October 1, 1975. According to the ERDA Controller, these negotiations are a long way from a mutually agreeable proposal.

INFORMATION ON URANIUM ENRICHMENT ASSOCIATES

UEA is planning to build a gaseous diffusion plant in southeastern Alabama, near Dothan. The plant, which would employ the gaseous diffusion enrichment process, would be able to produce 9 million SWU each year which would service about 90 large, present-generation nuclear powerplants. Preliminary ERDA estimates are that the plant will cost about \$3.5 billion (1976 dollars).¹ UEA estimates the plant will be initially operable in April 1981 with full-scale commercial production scheduled for July 1983.

The enrichment plant would require about 2,500 megawatts of electrical power, which is the amount generated by two large nuclear powerplants. About 50 million construction workhours are estimated to be necessary to build the plant, and about 1,100 people would compose the permanent operating staff at the plant project.

UEA is to be a U.S.-based corporation consisting of both domestic and foreign interests. Approximately 40 percent of the capital now estimated to be necessary to build the project, or about \$1.4 billion, is expected to be supplied by domestic organizations. UEA expects the remainder, \$2.1 billion, or about 60 percent, would be supplied by foreign entities. According to UEA, present market reviews indicate about 60 percent of UEA's enriched uranium output will be for the foreign owners with the remaining 40 percent for domestic customers. ERDA officials told us that the

¹Assuming inflation at a weighted annual rate of 7 percent, the costs through 1983 are estimated to be about \$5 billion.

contract between ERDA and UEA would set 60 percent as the upper limit for foreign financial interest.

Ownership and control of the project

Bechtel Corporation, a major architect-engineering and construction firm, and Goodyear Tire and Rubber Company are presently the only members of UEA. UEA expects another two to six U.S. companies to join in the project. These future participants are expected to be identified within the next few months.

Domestic partners will invest as equity 15 percent of their share of the estimated needed capital to build the project and will borrow the remaining 85 percent of its share. UEA officials expect foreign capital to be provided through irrevocable credit arrangements between foreign and United States banks, with payments made as construction of the project progresses.

Expected financing of the project
(1976 dollars)

	<u>Domestic</u>	<u>Foreign</u>	<u>Total</u>
	------(000,000 omitted)-----		
Equity investment	\$ 210	\$ 315	\$ 525
Debt	1,190	1,785	<u>2,975</u>
Total			<u>\$3,500</u>

Under the Atomic Energy Act of 1954, as amended, control of the project must remain in U.S. hands. UEA officials told us that it has established two new corporations--Uranium Enrichment Technology, Inc. and Uranium Enrichment Services, Inc. Uranium Enrichment Technology is to be wholly owned by UEA's domestic partners which ERDA must clear to have access to classified enrichment technology. It will handle all the classified aspects of the venture. Uranium Enrichment Services will handle the business aspects of the project and is expected to be composed of 40-percent domestic participation having 55 percent of the voting rights and 60-percent foreign participation with 45 percent voting rights. UEA officials stated that the domestic participants could vote as a block so that control of the project remains in domestic hands. ERDA told us the contract between ERDA and UEA would include a provision to insure domestic control.

According to UEA, the foreign countries who would most likely participate in the project and their potential maximum financial participation are as follows.

<u>Country</u>	<u>Potential financial participation</u>
France	10%
Iran	20
Japan	20
West Germany	11
Others (note a)	<u>5</u>
Total	<u>66%</u>

^aTaiwan, Italy, Switzerland, Spain, Portugal, Australia, and possibly others.

UEA officials told us they contacted each of the above countries and received an encouraging degree of interest but none had made strong commitments (such as letters of intent). The difficulties that UEA is having in securing foreign participation could be caused by

- uncertainty regarding the U.S. Government position on the project,
- concern over the limitations on equity voting rights, and
- concern over foreign access to U.S. enrichment technology.

Foreign customers will be allowed to resell any SWU they obtain if they comply with restrictions established by the Atomic Energy Act of 1954, as amended, and agreements for cooperation.¹ These restrictions impose certain export controls and prohibit the export of enriched uranium to any nation not covered by an agreement for cooperation with the United States.

¹Agreements for cooperation contain, among other things, a guaranty by the cooperating party that security safeguards and standards as set forth in the agreement will be maintained.

Domestic customers

As of the end of July 1975, domestic utilities had signed nine letters of interest with UEA for purchase of SWU as shown below.

Domestic letters of interest

<u>Company</u>	<u>Estimated quantities</u> (millions of SWU)
Alabama Power	9.5
Southern California Edison	5
Duke	3
Central Area Power Coordination Group	9
Gulf States Utilities	3
General Public Utilities	3
Public Service Electricity and Gas	9
Union Electric	5.5
Detroit Edison	<u>6</u>
Total	<u>53.0</u>

These letters of interest represent about 60 percent of needed domestic customers. UEA plans to supply enrichment services to domestic and foreign customers under 25-year contracts. According to UEA, each customer will be charged for its percentage of the total cost of operating the plant on a "take or pay" basis and will supply and retain title to the raw material needed for the enrichment process. These take-or-pay contracts will state that the purchaser of the enrichment service will be required to pay for the services irrespective of whether the purchaser actually takes the SWU for which it contracted. ERDA now uses and other private enrichers are expected to use similar contracts.

Some of the above-listed utilities now have contracts with ERDA for enrichment services. ERDA has told UEA that ERDA customers will be permitted to terminate their contracts with ERDA without penalty charges if (1) the customer signs a contract with a domestic enricher for an equal amount of enrichment services and (2) the loss of such contracts would not impair the ability of ERDA to sustain its plants at desired operating conditions. If a private enricher were to offer favorable price and payment conditions, ERDA customers could be expected to request termination of their ERDA contracts.

GOVERNMENT ASSISTANCE SOUGHT BY UEA

UEA says it requires Federal assistance to insure its viability as a commercial venture. According to UEA, Federal backup support is essential to bolster investor confidence in this project, which is lacking because a commercial history for this type of venture is nonexistent, uranium enrichment is a secret Government process, large capital investments and a long payback period are required, and domestic utilities credit worthiness has deteriorated.

Plant components

UEA has requested ERDA to supply essential plant components--enrichment barriers and seals--that are now produced only by ERDA.

According to ERDA, the barriers to be produced for UEA will be comparable to those produced for Government gaseous diffusion operations. The seals will be somewhat different than what ERDA presently produces and will require ERDA development and testing. UEA also expects to obtain design assistance from ERDA for components to be supplied by private industry.

ERDA plans to charge UEA for all costs ERDA incurs in supplying these components.

Process guarantee

The gaseous diffusion technology to be used in the UEA plant has been used successfully by the Atomic Energy Commission and ERDA since the 1940s. According to ERDA officials and to UEA financial advisors, however, the utility industry and the financial community are concerned as to how successful a secret technology will operate in a commercial environment. Therefore, UEA is seeking a performance assurance--an ERDA guarantee that the enrichment plant will operate successfully at full capacity--to protect domestic lenders and utility customers. ERDA's guarantee would last for 1 year after the plant demonstrates full-scale steady commercial operation.¹

The Government's potential liability, according to ERDA, would be to (1) replace, at the Government's expense, any defective ERDA-supplied equipment and (2) if necessary, assist in redesign and replacement of plant parts until the negotiated

¹To be negotiated, but ERDA expects the period to start after physical capability is demonstrated, not when the first output is delivered.

performance is attained. For the latter services, ERDA will require UEA to reimburse the Government for full costs.

ERDA would be given access to and approval of the manner in which the enrichment process is engineered, installed in the plant, and operated. ERDA would also help UEA design the plant and be reimbursed for its costs.

Technical assistance and know-how

Included in the UEA proposal is a request that ERDA provide technical assistance and know-how on the installation and operation of the gaseous diffusion process. UEA has told ERDA that it will need technical information, training, design assistance, and aid in evaluating potential suppliers and testing components.

ERDA has stated that up to 110 members of ERDA's and Union Carbide's (ERDA's contractor experienced in gaseous diffusion technology) staff could be employed in this effort. Assistance will primarily be scheduled to take place from 1975 through 1979. ERDA has estimated that this assistance will cost \$38 million (1976 dollars). UEA will be required to reimburse ERDA for all agreed upon assistance.

Access to ERDA stockpile

UEA has proposed that ERDA permit UEA to have access to the Government stockpile of enriched uranium. UEA wants 9 million SWU to be available to it at startup decreasing annually over the next 5 years of operation. UEA believes this access agreement is necessary in case (1) its supply during the early years is less than its customers' needs and (2) it is unable to meet its commitments because of a delay in completing the plant or a breakdown during its early operation.

For any ERDA-furnished SWU, ERDA says it would have the option to require UEA to replace SWU or to reimburse ERDA for it. Under the replacement option, UEA would replace SWU within 10 years or some other negotiated period. Under the reimbursement option, UEA would furnish the raw material as well as pay for the enrichment services at ERDA's price in effect at the time of transfer. In addition, because the UEA plant will--for the first year and a half of operation--be able to enrich uranium to a limited enrichment level (lower than design level), UEA would require access to ERDA's stockpile for the possibility of exchanging its enriched material for Government material enriched to a higher level.

ERDA officials told us that UEA would be required to pay the Government for any and all costs associated with the stockpile (such as carrying charges) and with exchanges of material. Also, they said that UEA would not be permitted to purchase Government SWU and to sell it at UEA's higher price.

Transfer of ownership

At UEA's request, the Government has the obligation to purchase the domestic owner's controlling interest in the UEA plant and the Government also has the option to take over ownership of the plant if such action is in the national interests. These options would terminate 1 year after the plant demonstrates full-scale steady commercial operation.

If ownership transfers, the Government would have to assume all domestic liabilities. Beyond this, the Government's payment to UEA for ownership would depend on the reason for the transfer. The Government would return all of the domestic equity and a return on the equity as determined by the Government, in case of events caused by the Government or otherwise beyond UEA's control, such as:

- Failure of warranted ERDA technology to operate to permit the plant to achieve commercial operation within the agreed on time and costs, despite reasonable efforts of both UEA and ERDA.
- Failure of Governmental licenses to be obtained in a timely manner or the application of law or regulation to prevent the plant from achieving commercial operation within the agreed on time and costs, despite reasonable efforts of both UEA and ERDA.
- Actions taken by ERDA for reasons of national interest in the matter of contractual relationships between UEA and previously approved customers to a degree which significantly threatens the economic viability of the project.
- Inability of UEA, because of lack of customer credit worthiness, to raise capital for construction or long-term financing despite reasonable efforts of UEA to do so.
- Such other events as may be mutually agreed on.

In case of events involving gross mismanagement, gross negligence, or willful misconduct by UEA, the domestic

investors would forfeit their rights for equity reimbursement. Prerequisites to finding gross mismanagement, gross negligence, or willful misconduct include (1) a formally written notice of deficiencies transmitted to UEA by the Government and (2) failure by UEA to respond reasonably to the notice.

A partial return of equity could occur depending on UEA's compliance with its commitments, the efforts of UEA, and the degree of fault. ERDA told us they are negotiating with UEA to define the situations which could result in a partial return of equity.

Foreign participants have more risk than domestic participants and lenders. Once foreign participants become committed to the project, their equity and debt cannot be purchased or assumed by the U.S. Government. On the other hand, all participants, including foreign participants, have U.S. Government assurance that the project will work. Successful operation of the project will effectively protect all investments in the project.

In the event of Government takeover of the plant, ERDA expects that foreign countries would continue to provide their prorated share of the funds to complete the plant, even if substantial cost overrun occur.

ERDA officials told us that all customers will have another substantial assurance from the Government. If the project is not brought to commercialization and the Government assumes the domestic debt and equity, the Government would provide the enrichment services to customers that they would have received from UEA, subject to Government terms and conditions, including price.

Federal purchase of UEA's enrichment services

UEA stated that some of its customers will not need enrichment services until a few years after the plant begins operations. Other customers will have irregular requirements before their nuclear powerplants reach full commercial operation. Accordingly, UEA has proposed that ERDA help smooth this supply-demand irregularity by agreeing to purchase up to 6 million SWU during the first 5 years of UEA's plant operation. Up to \$1.2 billion might be necessary for ERDA to meet this commitment. However, ERDA says it will sell these SWU and recover the Government's costs.

Return on equity

UEA's contracts with its customers will state that the price for enrichment services must include a 15-percent return on equity¹ after all Federal, State, and local taxes have been paid with such adjustments as may be necessary to attract quality equity participants. UEA's proposal, if accepted by its customers and ERDA, would essentially constitute a Government assurance that UEA will have this rate of return once the plant is proven operable.

POTENTIAL FINANCIAL COMMITMENT BY THE GOVERNMENT

As previously discussed, the Government's potential financial commitment would be for (1) reimbursing domestic participants if UEA is unable to complete the project and (2) purchasing up to 6 million SWU from UEA.

Other potential Government commitments should be recognized. For example, the cost of the Government's contingency plan; i.e., the design work that will continue while UEA is designing and building their facility, has not been included. Also, if the project is ultimately inoperable, the cost of power from two nuclear powerplants dedicated to the UEA plant less any revenues that can be earned from the sale of power to other users is a potential cost. Additional Government costs could be incurred if the Government took over after more than \$1.4 billion (to cover overruns) had been financed by domestic partners. ERDA says that any costs incurred by the Government in the UEA contract would eventually be recovered by the Government through sales of enrichment services.

In contrast to this considerable potential liability, UEA's domestic participants could forfeit their equity (estimated to be \$210 million in 1976 dollars) if UEA does not correct certain gross mismanagement, gross negligence, or willful misconduct after formal written request by the Government. According to ERDA, foreign participants could lose their entire equity investment and debt if the plant is not completed by either UEA or the Government.

ASSUMPTION OF RISK

Factual information related to assurances contained in the proposed legislation and sought by UEA as well as some

¹ Defined as their original investments plus an allowance for equity funds used.

of the costs to be borne by the Government have been discussed in this chapter. The assurances envisioned and the potential costs borne by the Government assure that the UEA venture, if approved, would be essentially riskless to UEA. The following sections compare the risks associated with normal business operations and how firms minimize those risks with the means by which UEA proposes to minimize risk and the extent to which those risks are minimized.

Firms face four basic categories of risk in their daily operation. These include risks associated with (1) variations in the supply of inputs (2) variations in the demand for output (3) the ability to obtain external funds and the costs associated with obtaining those funds and (4) competition from other producers.

Variations in supply

A continuous, assured supply of raw materials is necessary to minimize costs associated with production interruptions and to maximize the probability of a smooth flow of goods through the production process. Minimizing this risk involves maintaining raw materials inventories which is costly.

Under UEA's system, the responsibility for raw materials acquisition and inventorying belongs to the utilities that contract for enrichment services. Consequently, UEA will avoid the very costly maintenance of raw materials inventories.

Variations in demand

An adequate supply of finished goods must be kept on hand to offset variations in demand. This inventory is also necessary for interruptions which may occur in the production process--most notably, labor interruptions. There are obvious costs associated with maintaining finished good inventories.

In UEA's case, take-or-pay contracts minimize variations in demand, and the stockpile purchase agreements with ERDA enhance the possibility that supply and demand are equated at full capacity. The Government would not only maintain a 9 million SWU inventory for UEA but also would agree to purchase SWU when demand declines. UEA's proposal would obtain a perfect hedge against risks associated with demand variation for as long as Government guarantees are in effect. After Government assistance expires, the costs associated with providing and maintaining a stock of finished goods will be borne by UEA's customers. To the extent the stock is inadequate, UEA could bear a financial loss.

Obtaining external funds

Variations in revenues sometimes create situations in which a firm cannot pay the interest on its long-term debt obligations or pay off its short-term liabilities. When such a situation arises, the firm's credit worthiness declines and the costs at which it is able to borrow rise substantially. In fact, when a firm fails to cover its debt-servicing costs, it may not be able to borrow at all. The financial risks that a firm faces are directly related to the extent to which all other normal business risk has been hedged. In other words, a firm's ability to obtain financing at reasonable costs is dependent upon the probability of default which in turn is related to such operating characteristics as variability in demand and competition. Financial risks are thus hedged through minimizing operating risks.

In UEA's proposal, not only would normal operating risks be hedged but also it is proposed that the Government guarantee the domestic debt and, unless the Government proves gross mismanagement, gross negligence, or willfull misconduct, the domestic equity against default in the event that the plant is not completed.

Competition

Firms also face risks associated with competition. The principal risk from competition is that prices will be bid to a level so low that the rate of return to inefficient firms is insufficient to induce them to remain in the industry. Firms' rates of return are generally reduced through the entry of more efficient firms which, because of reduced costs, are able to underprice existing firms.

UEA has hedged against the risks associated with competition after Government assurances have ended through cost passthrough pricing and, perhaps more importantly, through 25-year take-or-pay contracts with utilities. Under arrangements where goods are priced on the basis of cost passthrough pricing, there is no incentive to reduce costs since price will always exceed costs by some amount. Under UEA's proposal, prices are to be set to provide a minimum 15-percent return on equity after coverage of production and debt-servicing costs and taxes. The industry will be subject to the Nuclear Regulatory Commission's regulations. There is, however, no indication of the Government's intention to regulate price.

Moreover, there is no stimulus for price change when new firms enter the industry because of the take-or-pay contract method of sales. Without take-or-pay contracts,

entry of gas centrifuge and laser isotope separation technologies might pose a real competitive threat to UEA's gaseous diffusion enrichment process. If cost efficiencies of centrifuge and laser technologies were sufficiently great, their entry might render gaseous diffusion obsolete. But because of take-or-pay contracts, UEA is effectively shielded from the effects of price competition resulting from technological change for 25 years. If UEA's costs and required rate of return imply a level of prices above that at which gas centrifuge producers operate, then UEA's prices will not fall to the lower level because there is no risk of loss of demand when prices are maintained at the higher level. Demand for UEA's services is completely inelastic under take-or-pay contracts.

Options for Government takeover of project

The UEA proposal contains options for a change in the domestic ownership of the diffusion plant from UEA to the Government at the end of construction. The options, under various conditions, provide assurances to UEA lenders, UEA, and the Government.

The debt financing during construction of the plant will be provided by commercial banks as construction loans. At the end of the construction, UEA intends to issue long-term bonds and use these receipts to retire the bank debt. However, even though UEA intends to repay the bank debt from the issuance of bond receipts, this may not be feasible if the capital markets are extremely tight or if the ratings of the utilities, which are UEA's customers and sources of funds, are low due to their economic circumstances. The banks would consequently grant such construction loans only if they were assured that UEA would have sufficient funds to retire the debt. For this reason and others, UEA proposes that the contract contain an option that either UEA, at its initiative only, could require that the Government purchase the plant from UEA with no penalty (providing that UEA were not guilty of gross mismanagement) and with additional compensation, as determined by the Government to reflect the results achieved to date of transfer or that the Government, at its option only, purchase the plant from UEA under similar conditions.

The options obviously protect UEA also. If at the end of the construction period, UEA did not deem the project to be commercially viable, as evidenced by its lack of ability to raise debt capital or for other reasons, UEA could turn over the project to the Government. Consequently, barring gross mismanagement, gross negligence, or willful

misconduct, the project is essentially riskless for UEA through construction and the first year of operation.

Alternatively, the options could serve to the disadvantage of UEA if the Government exercised its option to purchase the plant.

Risks borne by UEA

The Government takeover provision will expire about 1 year after successful commercial operation, and UEA access to ERDA's stockpile of SWU expires after 5 years. With the expiration of these assurances, UEA will be assuming any risks involved in operating its plant. However, UEA's 25-year contracts and cost passthrough pricing concept, as well as no foreseen price regulation, would act to minimize these risks.

It should also be noted that the greatest risks associated with a project of this nature are during construction and initial operation.

The proposed legislation provides that UEA risks losing its domestic equity to the Government in the event of gross mismanagement, gross negligence, or willful misconduct by UEA. The burden of proof will be on the Government. It is difficult for us to visualize any circumstances where the Government could prove gross mismanagement, gross negligence, or willful misconduct, because the Government will be involved in providing UEA with technical assistance, design assistance, personnel training, enrichment process review, potential supplier evaluation, and component testing. A partial loss of equity could occur depending on UEA's compliance with its commitments, the efforts of UEA, and the degree of fault.

OTHER PROPOSALS

The Nuclear Fuel Assurance Act could apply to any organization that wishes to build, own, and operate uranium enrichment plants independent of the technology used. Our analysis has focused on the UEA proposal because of the advanced nature of the proposal and because it may provide the next increment of capacity.

ERDA has requested proposals by October 1, 1975, from organizations desiring to construct uranium enrichment plants using the gas centrifuge technology. ERDA received proposals from CENTAR Associates, Garrett Corporation, and Exxon Nuclear. ERDA believes these projects will proceed at the same pace and only slightly behind the UEA project. Our discussion with these potential centrifuge enrichers indicated that they desire certain forms of government guarantees and

assurances which in some respects are similar to those being requested by UEA, but in other respects are different. The differences occur primarily in degrees of risk assumed, equity-debt ratios, and the extent of foreign participation, if any.

Garrett Corporation

Garrett Corporation is largely in the business of manufacturing equipment which generates, transforms, or controls energy. Garrett participates in uranium enrichment as a research and development contractor to ERDA and as a potential commercial supplier of equipment and services.

Garrett was selected by the Atomic Energy Commission as a research and development contractor in 1961 and has served continuously since that date in a program of centrifuge machine development. Through this research and development contract, Garrett has completed installing a pilot manufacturing line and is supporting the pilot centrifuge enrichment plant at Oak Ridge by supplying centrifuge machines and the necessary assembly and installation personnel.

On October 1, 1975, an independent business entity--called Texas Regional Enrichment Corporation--submitted a proposal to construct a centrifuge enrichment plant. The equity for this corporation is to be supplied by Garrett Nuclear Corporation, a wholly owned subsidiary of Garrett, and possibly other investors. This corporation plans to build a 3 million SWU centrifuge plant. Initially, production of about 350,000 SWU is planned for mid-1981 and expanding to a total 3 million SWU by 1987. Two Texas utility's will contract for a substantial portion of the enriching services from this plant.

Garrett officials told us its proposal will be requesting Government assurance in the areas of (1) process guarantees, (2) completion guarantees, and (3) some early access to the Government SWU stockpile. Also, Garrett will be seeking foreign investment in its plant.

CENTAR Associates

CENTAR Associates is a joint venture of Electro-Nucleonics, Incorporated Nuclear Company (a subsidiary of Electro-Nucleonics, Incorporated), and Atlantic Richfield Company Nuclear Company (a subsidiary of Atlantic Richfield Company). Electro-Nucleonics was founded in 1960 to engage in gas centrifuge research and development to establish a capability to produce gas centrifuges and related equipment to produce enriched uranium. In 1963 they entered into a joint venture with W. R. Grace and Company to build a small

gas centrifuge pilot plant. This plant was operated from 1965 to 1967.

In March 1967 the Atomic Energy Commission determined that it was not in the national interest that private supported centrifuge work be continued. However, Electro-Nucleonics was awarded an Atomic Energy Commission contract to develop certain gas centrifuge components for the Government's gas centrifuge program.

Atlantic Richfield joined Electro-Nucleonics in 1974 and CENTAR Associates was formed. CENTAR plans to build a 3 million SWU centrifuge plant. Initially, production capacity for about 270,000 SWU is planned for 1981, expanding to 3 million SWU by 1986. CENTAR submitted a proposal on October 1, 1975, to construct a centrifuge enrichment plant.

CENTAR officials told us that their proposal requests forms of Government assistance and offers to accept degrees of risk different from those UEA is proposing. CENTAR seeks temporary Government underwriting of the debt portion of the financing in the form of guarantees of the Government's technology. CENTAR also proposes a 75 percent debt and 25 percent equity ratio and is prepared to accept loss of its equity investment in case of project failure with one exception, namely, a government action which precludes CENTAR's continuance as a commercial venture. ERDA is also requested to make available a supply of SWU's to support and supplement the production of the CENTAR plant during the early years of operation.

CENTAR is not seeking foreign investment in their initial plant, but is willing to furnish enrichment services to foreign customers.

Exxon Nuclear Company, Inc.

Exxon Nuclear Company, Inc., is the wholly owned affiliate of Exxon Corporation responsible for the development and execution of Exxon's commercial nuclear fuel cycle products and services.

Exxon Nuclear submitted a proposal on October 1, 1975, to construct a centrifuge enrichment plant. Exxon plans to build a 3 million SWU centrifuge plant. The initial capacity of 1 million SWU would be operational in the 1981-82 period, with full production several years later.

Exxon Nuclear officials told us that, for the private sector to become involved in uranium enrichment, the proper climate would have to be provided. This would include (1)

certain Government assurances in the areas of process guarantees, (2) buying and selling SWU on a commercial basis, (3) completion guarantees, and (4) Government assurance to pick up defaulting utility obligations (particularly foreign utilities).

The Exxon Nuclear officials told us that for the first 1 million SWU increment it did not anticipate any foreign equity but that it would seek both domestic and foreign customers.

CHAPTER 3

FACTORS IMPACTING ON WHETHER INDUSTRY OR GOVERNMENT SHOULD PROVIDE THE NEXT INCREMENT OF ENRICHMENT CAPACITY

This chapter contains an analysis of various factors impacting on whether the next increment of uranium enrichment capacity should be provided by private industry or by the Government. The factors are:

- reasonable price for enriched uranium,
- foreign implications,
- safety safeguards and sabotage,
- cash flow impact on the U.S. Treasury, and
- cost and timing of the next enrichment capacity.

REASONABLE PRICE

If the next increment of enrichment capacity were Government owned and operated, a reasonable price should be insured through congressional and executive branch oversight. If the next enrichment increment was privately owned, a reasonable price would depend on whether a viable competitive market would result and, if not, whether methods of Government regulation or control could correct an otherwise unsatisfactory competitive balance.

UEA's price for enriched uranium will be based on a cost passthrough concept. Consequently, all UEA's costs plus a 15-percent return on equity will be paid by UEA's customers. Also, UEA's take-or-pay contract would not permit its customers to terminate the contracts in favor of another enricher if UEA's price was not competitive.

ERDA feels that the proposed legislation will spur competition in the uranium enrichment industry and that price regulation will not be necessary. ERDA sees the UEA plant as a desirable step to full competition, because it will demonstrate to the private sector that a privately owned plant, with Government assistance, can operate successfully. UEA officials told us they believe competition to their plant will come from foreign nations and other domestic firms.

ERDA sees increased competition developing with the arrival of the gas centrifuge process. Because centrifuge

process plants can be built on a smaller scale than gaseous diffusion plants, ERDA expects several firms to enter the uranium enrichment industry, thereby increasing competition.

The Edison Electric Institute, in its June 1974 report "Uranium Enrichment Facilities," commented on whether there will be effective competition in the uranium enrichment industry or whether price regulation will be required.

"The question of price regulation is not clear cut. On the one hand, the business of providing enrichment services on a commercial basis has several characteristics which could act to inhibit free competition among suppliers. For one, the magnitude of the capital investment entailed in entering this market, which derives from economy of scale considerations fundamental to the existing technologies, can be expected to restrict the number of competing enterprises. For another, the long-term nature of the contract commitments required, especially where the venturer must protect against technical obsolescence of facilities in which he is making a large and heavily debt-financed investment, act to 'lock in' customer accounts and thereby diminish opportunities for competition. For a third, the 'customer' is a public-service industry that is itself regulated. On the other hand, there are several factors which augur well for the evolution of a highly competitive supply industry. Most obvious of these is the indicated rapid growth in demand for enrichment services. Another is the indicated promise of the centrifuge process, the employment of which should facilitate competition among suppliers. Still another is the compactness of nuclear fuel, which by reducing transportation costs to a nominal consideration, facilitates the emergence of a competitive world market."

We believe that because (1) the magnitude of capital investments required could limit the number of firms in this industry, (2) the long-term nature of enrichment contracts precludes customers from "shopping around" for better prices, and (3) the uncertainties regarding the demand for nuclear power, the likelihood of a highly competitive uranium enrichment industry is not great.

FOREIGN IMPLICATIONS

It is important for the United States to maintain as much of the foreign market as possible to (1) maximize our balance of payments position, (2) obtain the commitment of additional

nations to accept the principal of nuclear nonproliferation, and (3) cooperate with other major oil-consuming nations which are looking to nuclear power to help reduce their dependence on foreign oil imports. Several foreign countries are constructing enrichment capacity, and the longer this country delays in constructing new capacity, the worse our position will be in competing for foreign customers. ERDA estimates that U.S. enrichment suppliers will capture about 30 percent of the foreign demand.

An analysis of the effect of Government versus private ownership on balance of payments would involve making a number of judgemental assumptions. Capturing as much of the foreign market as possible ultimately will result in the greatest inflow of dollars to the United States regardless of ownership.

U.S. enrichment sales to foreign governments has been a factor in limiting the spread of nuclear weapons. For example, sales of enrichment services have been used as leverage to obtain safeguards and nonproliferation guarantees. Enrichment sales have also been an important factor in enlisting the support of other nations in using nuclear power as an alternative to oil. As other nations find new sources for enrichment services, the United States may lose the leverage that a dominant trading position provides.

SAFETY AND SAFEGUARDS

Although the proposed legislation makes no specific mention of accidents, sabotage, safety, or nuclear proliferation as related to enrichment facilities, there is considerable public interest in these topics. Expanding U.S. uranium enrichment capacity has ramifications in all these areas. However, there appears to be little difference between privately owned or Government-owned capacity with regard to these topics.

Enrichment plants safety

Gaseous diffusion and gas centrifuge plants will process fissile materials¹ that could accidentally produce a critical mass reaction--a chain reaction resulting in a release of thermal energy. However, because of the required design reviews, detailed operating procedures, administrative controls, and regular nuclear safety surveys, there is general

¹Any material that will fission by neutrons of all energies or split into two parts, accompanied by the release of a large amount of energy and generally one or more neutrons.

agreement that probability of a critical accident is extremely small. In 30 years of operating history of existing gaseous diffusion plants, no critical accidents have occurred. If a critical accident would occur, most of the radioactive materials would be contained in the enrichment equipment or building. The immediate vicinity would incur minor contamination.

Sabotage

According to ERDA, an act of sabotage at an enrichment facility would not result in a nuclear explosion. The expected objective of saboteurs would be to inflict as much damage as possible so as to shut down the plant for a period of time (days to weeks, depending on the damage).

Every type of sabotage at the plant could not be prevented. A well-trained, well-armed terrorist group could damage the plant. It is anticipated that the major deterrents to acts of sabotage, a trained- and armed-security contingent, will be adequate. No unauthorized entrance to the plant will be allowed. An exclusion area surrounding the plant will be established and protected by armed guards. The Nuclear Regulatory Commission, through its licensing process, will be responsible for determining whether safeguards will be adequate.

Nuclear material theft

A person with the requisite technical expertise and the necessary resources could make a crude nuclear weapon from about 17 kilograms¹ of highly enriched uranium. The possibility that nuclear material could be stolen, lost, or diverted from authorized use increases as the number of facilities --such as enrichment facilities--having such material increases. Whether the facility is Government owned or privately owned should not influence the probability of theft.

It is a physical possibility for private enrichment plants to produce sufficiently enriched uranium for use in nuclear weapons. This would have to be done covertly as the Atomic Energy Act of 1954, as amended, expressly prohibits the production of uranium for weapons by any organization other than the Government. Because of economic penalties, licensing, and safeguard requirements, however, it is not a practical alternative for a private plant.

¹A kilogram equals approximately 2.2 pounds.

UEA told us that for its proposed plant to produce weapons-grade material, it would have to (1) add additional capacity at a cost of about \$700 million and add almost 2 years to the construction schedule, or (2) send the product elsewhere for further enrichment, or (3) recycle the product at the plant causing tremendous fluctuations in power consumption, diversion of considerable amounts of inventory from its customers, and high costs. Actions of this magnitude should alert the Government to such clandestine activities.

Safeguarding nuclear material at enrichment facilities is subject to provisions of the Atomic Energy Act of 1954, as amended. The Nuclear Regulatory Commission is responsible for insuring that all special nuclear material, including the material produced by enrichment plants, is effectively safeguarded from unauthorized use. Privately owned enrichment plants will be subject to periodic inspections and enforcement by the Nuclear Regulatory Commission.

Nuclear weapons proliferation

Both the diffusion and centrifuge enrichment processes can enrich uranium so that it could be used in nuclear weapons. Therefore, it is necessary to prevent enrichment technology from falling into the control of nations or subnational groups that would construct and operate an enrichment plant to produce material for nuclear weapons.

Expanding enrichment capacity in the United States regardless of ownership increases the potential that classified enrichment technology could illegally or inadvertently be disclosed to countries or groups presently without an enrichment capability. An ERDA official told us that about 10 percent of the people employed at an enrichment facility would have access to classified enrichment information.

Security measures for protecting classified enrichment technology include physical protection, personnel clearances, and possible fine and imprisonment for violation of relevant legislation. ERDA believes these measures are adequate but can be increased if necessary.

On February 11, 1974, the Secretary of State opened the Washington Energy Conference by stating, in part, that the United States is prepared to examine sharing diffusion and centrifuge enrichment technology with other nations. ERDA's present policy is to permit domestic companies which expect to provide enrichment capacity in the United States to initiate unclassified discussions with foreign entities within the confines of the Atomic Energy Act, as amended,

and the requirements of Title 10 of the Code of Federal Regulations, Part 110 Rules and Procedures. The Government has told industry that it should not assume that the Government would approve a proposed arrangement that would result from commercial negotiations. Any arrangements would be subject to an appropriate Agreement for Cooperation between the United States and the country or countries of the foreign entity. The Government findings as to the acceptability of such proposals would be judged on the basis of:

- compatibility with overall foreign policy objectives, including effective international energy cooperation,
- assurance that international security interests would be protected,
- assurance of support of domestic U.S. interests, including the surety of U.S. fuel supply needs being met by the establishment of a competitive private supply industry, and
- reasonable compensation to the U.S. public for Government-developed technology.

State Department officials told us that informal discussions have taken place with foreign countries but no applications have been made for sharing enrichment technology.

CASH FLOW IMPACT ON THE U.S. TREASURY

If private industry provides the next increment of enrichment capacity, the Government would not incur any construction costs and would receive taxes and royalties from the private enrichers.

While the UEA proposal would remove the costs of construction from the Federal budget, so would a number of other alternative arrangements, including forms of Government ownership which could have self-financing authority and the ability to borrow funds from the public.

In addition, if the Government builds the next increment of enrichment capacity and it is financed through the U.S. Treasury, in time a positive cash flow to the Treasury would result because revenues generated by its existing plants and the additional capacity and the existing plants would exceed the Government's cost. ERDA estimates that by fiscal year 1990 such revenues would exceed cost by about \$8.3 billion assuming a price for its enrichment services of \$76 per SWU.

Projections of costs and revenues to the year 1990 necessarily involve predictions of future market conditions and are subject to much uncertainty. The credibility of such projections decrease as the period of time over which they are made increases. We do not place great importance on the absolute amount of revenues ERDA has estimated will be generated by 1990 or on when costs incurred in building the add-on will be recouped. However, we do feel it is important to point out that cumulative revenues from the three existing Government plants and the proposed add-on will exceed cumulative costs by 1981.

COST AND TIMING OF NEXT ENRICHMENT CAPACITY

Both UEA's schedule and the ERDA contingency plan call for additional capacity to be provided in 1983. UEA plans to have its entire 9 million SWU plant operating by July 1983. ERDA's contingency plan calls for building an add-on diffusion plant at Portsmouth. The add-on plant would have an initial capacity of 4.4 million SWU; however, capacity could be expanded to 8.8 million SWU without a major cost penalty if authorization for such expansion is received within 2 years after the first half-size plant is authorized. ERDA estimates that the construction cost of increasing the enrichment capacity of the Portsmouth plant by 8.8 million SWU would be about \$2.1 billion (1975 dollars). UEA's estimate to build a 9 million SWU enrichment plant is about \$3.3 billion (1975 dollars), which includes about \$2.7 billion (1975 dollars) for construction. These figures show that an add-on plant is cheaper to construct than a stand-alone plant.

Because an add-on plant initially could be built at half-size, it could minimize the amount of diffusion capacity constructed. That is, the half-size capacity could buy time until the more efficient centrifuge process is developed for commercial use.

UEA's schedule

According to UEA officials, its enrichment facility will be fully operable by July 1983. Major milestones for bringing UEA's plant on line are:

Apply to Nuclear Regulatory Commission
for construction permit to build enrichment facility.

August 1, 1976

Begin construction of two nuclear
powerplants.

January 1977

Receive limited work authorization ¹ from Nuclear Regulatory Commission.	July 1, 1977
Receive construction permit from Nuclear Regulatory Commission.	January 1, 1979
Initial operation.	April 1, 1981
Full production.	July 1, 1983

Several factors indicate that UEA's schedule may be optimistic. According to ERDA and ERDA contractor officials, UEA has made insufficient allowance for contingency factors and testing of certain components. These officials told us that the schedule, although possible to achieve, could be optimistic by as much as 1 to 2 years.

According to ERDA, Southern Company² will supply 2,400 megawatts of electric capacity to UEA's project through Alabama Power Company, which will build and operate two large nuclear powerplants dedicated to the enrichment plant.

UEA officials told us that they anticipate having enough power when required, because they will use much of the design work that has already been completed for two other nuclear reactors that have received construction permits but have been postponed indefinitely because of lack of consumer demand and financing difficulties.

Nuclear Regulatory Commission officials told us that the powerplants will have to be relicensed and that they expect Alabama Power Company to petition the Nuclear Regulatory Commission to begin its licensing review as soon as the Government agrees to assist UEA in building the enrichment plant.

UEA's schedule is predicated on building the nuclear reactors in 60 months. During 1974 nuclear powerplant construction was averaging 72 months. Estimates for 1975 and 1976 are 82 and 79 months, respectively. Accordingly, UEA's construction schedule may be optimistic and difficult to achieve.

¹Allows preparation of the project site, but no major construction of the process building is permitted.

²A holding company whose operating affiliates are Alabama Power Company, Georgia Power Company, Gulf Power Company, and Mississippi Power Company.

If the two powerplants are not able to produce enough power for the UEA plant, UEA will be required to obtain its power from other sources. In this case, whether Alabama Power Company will be able to supply all 2,500 megawatts of electricity required in 1983 is questionable because it currently estimates having a reserve capacity of about 1,600 megawatts at that time. If available, the additional electricity needed could be supplied from the Southern Company's reserve system.

Government's schedule

The Government's add-on plant schedule calls for initial operation early in 1983. To meet this schedule several actions must be taken in the next few months concerning plant design and power supply.

Plant design

Plant design should begin by January 1, 1976, with March 31, 1976, the latest possible date to begin design. To meet the January 1 design start, an additional \$6 million funding authorization over the current fiscal year 1976 budget is needed. ERDA's schedule called for receiving such authority by July 1976. However, ERDA has not submitted a request for authorization. The Joint Committee on Atomic Energy added \$25 million to ERDA's fiscal year 1976 budget to cover such items as plant design and long leadtime items associated with the add-on. This budget has yet to pass Congress.

ERDA officials told us the request for proposals from architect-engineering firms is being prepared and will go out soon. They expect the contract could be awarded by January 1976.

Power supply

To insure power availability for the add-on plant, negotiations should start by January 1, 1976. A letter agreement with the power suppliers would be executed by October 1976, with the definitive contract completed by April 1977.

ERDA has contacted a power supplier in the Portsmouth area--the American Electric Power Company--to determine its interest in providing the needed electricity. Coal-fired plants would be used, and Ohio siting requirements would have to be met. This company told ERDA they would consider furnishing the needed power provided that a new subsidiary corporation be set up with the Government guaranteeing its securities. We think it is doubtful that the Government will guarantee a utility's securities.

ERDA officials told us that ERDA is now studying potential problems regarding power supply for a Government add-on, including the request for Government guarantee of securities.

CHAPTER 4

ALTERNATIVE FORMS OF GOVERNMENT OWNERSHIP

If the Government were to provide the next increment of enrichment capacity, there would be drawbacks to providing this capacity under ERDA's existing structure. The annual budget and appropriation process could prevent the business-like conduct of the enriching activity. The budget process has delayed implementing the Cascade Improvement Program and Cascade Upgrading Program.¹ Also under the existing structure, enrichment activities must compete for funds with other ERDA programs.

This chapter contains a description and analysis of various forms of Government ownership in which more business-like operations should be possible.

CONTINUED OPERATION WITHIN ERDA WITH SELF-FINANCING AUTHORITY

Establishing a self-financed uranium enrichment enterprise as a subdivision of ERDA is an alternative which could involve the least amount of change from the present organization. This alternative has also been referred to as a Directorate within ERDA. No change in management or operational personnel would be necessary, and little, if any, change would be required in the organization structure. This arrangement would also avoid interfacing problems with ERDA that would have to be resolved if any independent corporation were established.

Operating the enterprise could be financed by reapplying revenues for enriching services (for example, through a revolving fund) and could be augmented by appropriations from the Federal Government through the conventional budget process whenever costs exceed revenues. Revenues in excess of needs would be repaid to the Treasury. Financing could also be provided by reapplying revenues and by borrowing from the public and/or the Treasury.

With authorization to reapply revenues and to borrow funds, the enterprise could operate within ERDA to provide

¹The Cascade Improvement Program will incorporate the latest technology into the existing plant equipment. The Cascade Power Upgrading Program will permit effective use of larger amounts of electric power in the existing and improved equipment.

additional capacity as needed without the leadtimes and other considerations associated with obtaining funds through the budgetary process, in which the enrichment activities would have to compete for funds with all other Government programs and in which judgments would be made on bases other than minimizing costs of an industrial-type activity.

Treasury borrowings are the least expensive debt funding. These borrowings are treated as part of the public debt and therefore are subject to the public debt ceiling. An example of a Government corporation having authority to borrow from the Treasury is the Tennessee Valley Authority.

Direct borrowings from the public could furnish some added flexibility in providing for improvements and expansions and in providing for funding of operations without regard to the public debt ceiling. The Tennessee Valley Authority has been granted this authority.

As to the possible disadvantages of this organizational arrangement, policies governing operation of the plants could be affected by other ERDA policies and programs rather than determined on a strictly businesslike basis.

An example of a commercial-type enterprise operating within the Government with authority to reapply revenues is the Government Printing Office. A revolving fund was established for the Government Printing Office; this fund is replenished by excess revenues from printing and binding work for the Congress and Federal agencies over operating expenses, including depreciation of equipment and building improvements.

The enterprise may either serve as a permanent form of Government organization or as an intermediate step leading to the creation of a Government corporation.

This alternative was suggested several years ago by the Atomic Energy Commission but was abandoned because of strong adverse congressional reaction to the potential use of the enterprise as a vehicle for transferring ownership of the Commission's existing enrichment plants from the public to the private sector. The enterprise can be established with provision that existing Government plants not be transferred to the private sector. This enterprise would be easier to implement than a Government corporation.

Without borrowing authority, the enterprise would depend on appropriations through the conventional budget process whenever costs exceed revenues.

WHOLLY OWNED GOVERNMENT CORPORATION
WITHIN ERDA

Establishing a Government corporation within ERDA could permit operation of enrichment plants on a businesslike basis without requiring considerable changes in the current organization. The corporation could be financed independently of ERDA's appropriations by reapplying revenues and by borrowing from the Treasury and/or the public. Organizationally, the corporation would be managed by the Administrator and a Board of Directors he designates.

The corporation's business-type budget would be transmitted to the Office of Management and Budget and the Congress. Because of the self-financing arrangement, funding for operations, long-range plant improvements, and construction programs would not depend on the annual budgetary and appropriations procedures. The corporation would still be subject, to some extent, to Government policy constraints on expenditures and debt management, depending on legislative limitations placed on the corporation. For example, a debt ceiling could be imposed to control expansion.

This form of corporation is the simplest and most direct approach. This corporate structure would also result in minimum disruption of established organizational and operating arrangements. It would maintain a single focal point for all atomic energy policy and management and thereby provide consistency of uranium enrichment policy in relation to other atomic energy programs. This mode of Government operation could either continue indefinitely or later be converted to a private organization.

The corporation would take longer to implement than a Directorate and would also require legislation. The continued interrelationship with ERDA could affect the operations of the corporation because of the influence of ERDA's policies and procedures which related to ERDA's other responsibilities.

WHOLLY OWNED INDEPENDENT
GOVERNMENT CORPORATION

A wholly owned independent Government corporation with self-financing authority would enable the operation of the enrichment plants to be conducted as a business-type enterprise. The corporation could be managed by a board of directors whose members would be selected solely for their managerial ability without an attempt to gain representation of any particular segments of industry or Government.

Establishing an independent Government enrichment corporation would (1) tend to eliminate any appearance of preferential treatment for Government activities and to present less of an appearance of subsidy, (2) provide for direct representation of a broader range of interests by including industry representatives on the board of directors, and (3) eliminate the possibility of conflict between ERDA and corporate interests in staff use.

It should be noted, however, that an independent corporation would (1) create the possibility of conflict between corporate policy and the actions and policies of ERDA and (2) essentially preclude use of the special skills and experience of certain key ERDA employees by either the corporation or ERDA.

Of existing Government corporations, the organization and financing of the Tennessee Valley Authority power program probably would most closely resemble those needed by an independent enrichment corporation which must raise large amounts of money from borrowings and revenues for its power program's construction activities. The Authority's nonpower activities are financed through congressional appropriations. Management is vested in a three-member board of directors, appointed by the President for staggered 9-year terms, and a general manager. The board is responsible to the President and is required by law to submit periodic reports to the Congress.

Another approach would be to establish a board of directors appointed by the President, which would consist of any number of persons but presumably a somewhat larger number than the Authority's board, to represent parties, such as the electric utilities, the nuclear industry, and the financial community. The board likely would serve on a part-time basis and would be responsible for decisions on broad policy matters and for general supervision of the corporation.

GOVERNMENT CORPORATION WITH JOINT GOVERNMENT AND PRIVATE OWNERSHIP

An independent Government corporation with partial private ownership would probably operate more like a private corporation than any of the alternatives discussed previously. The corporation would be self-financing from revenue and could obtain funds for improvement and construction programs from the sale of stock, bonds, and notes.

The capital structure of a mixed Government-industry corporation could consist of capital stock issued by the

corporation, the majority of which would be retained, at least initially, by the Treasury and the remainder sold either to domestic and foreign enrichment services customers or to the public. A stock offering of this nature could serve as an important source of capital to the enrichment corporation, especially in the next few years when costs are projected to be substantially greater than revenues.

This mechanism could assist private industry entering the enrichment business by initial risk sharing. Additional capacity built under this mechanism could eventually be transferred to private industry. Also, through Government control of the board, responsiveness to Federal policies can be insured. Finally, it provides the opportunity for foreign participation in equity financing.

Drawbacks include possible management conflict due to differing objectives of Government and industry. Also the capital structure of this option would be more complex.

CHAPTER 5
CONCLUSIONS

If the use of nuclear power to generate electricity is to grow, then the Nation must develop additional uranium enrichment capacity to meet the needs of domestic and foreign customers. While the immediacy of the need cannot be stated with certainty, additional capacity is projected to be needed as soon as the early 1980s. Because of the long lead time associated with the design and construction of enrichment facilities, prompt decisions regarding the amount, the type, and the manner of that capacity are needed.

The Administration has proposed legislation intended to facilitate both decisions and action on this matter. The Administration proposal, which is intended to encourage "privatization" of the enrichment process would:

1. Authorize ERDA to enter into cooperative arrangements with as many private firms that wish to build, own, and operate enriching plants as the ERDA Administrator believes necessary to develop a competitive industry.
2. Authorize ERDA to provide various forms of assistance and assurances under such arrangements.
3. Limit the Government's total potential liability to \$8 billion in the event that the private ventures fail and the Government has to take them over.
4. Authorize ERDA to start construction planning and design activities for expanding one of the Government's existing enrichment facilities as a contingency measure.
5. Provide for congressional review of the basis for the cooperative arrangements by the Joint Committee on Atomic Energy.

The response of private industry to the Administration proposal has been mixed. With respect to the next increment of uranium enrichment capacity, using the gas diffusion process, only a single proposal has been received by ERDA, an offering by Uranium Enrichment Associates. On the other hand, several proposals have been received with respect to

subsequent increments utilizing more advanced centrifuge technologies.

The limited industry response with respect to using the gaseous diffusion technology for the next increment of capacity and the nature of that response increases the relevance of the portion of the Administration's legislative proposal which supports ERDA's in-house efforts which would be necessary to develop and add on to existing Government facilities.

There are basic differences between a decision on providing the next increment of uranium enrichment capacity and providing additional increments which may be required in the future. While it might be possible to move immediately to the newer gaseous centrifuge process to provide the next increment, it is generally agreed that if the next increment of uranium enrichment capacity is the proven gaseous diffusion technology the country will be more certain of an adequate supply of enriched uranium during this period of transition between diffusion and centrifuge technology. Gaseous diffusion plants owned by the Government and operated under contract by private firms have been operating successfully for over 30 years.

Any new gaseous diffusion uranium enrichment capacity that is constructed is likely to be the last-of-its-kind in the United States. Future U.S. uranium enrichment capacity will most likely use the gaseous centrifuge or other advanced enrichment processes since they offer potential advantages over diffusion technology in such areas as total cost, energy use, flexibility, and simplicity. This potential for technological obsolescence of the diffusion process, taken together with other factors cited in the report, makes it unlikely that any private firm would undertake the construction of a last-of-a-kind gaseous diffusion plant without considerable Government assurances and guarantees. The Administration's proposal provides such guarantees in order to insure the "privatization" of the enrichment process. However, existing information made available by ERDA officials indicates that equivalent additional capacity can be added on to an existing plant at less than the cost of constructing a new stand-alone gaseous diffusion plant.

ERDA makes two basic arguments in favor of accepting the UEA proposal. First, the UEA plant would demonstrate to the private sector that a privately owned plant--with Government assistance--can operate successfully. Second, private construction of the plant would have a favorable budgetary impact since the Government would not likely incur any direct costs and would receive royalties and taxes.

It is true that building and operating the UEA plant with Government assistance would serve to demonstrate that the Government is committed to fostering the "privatization of" the enrichment industry. Also it would demonstrate--in a technical and industrial sense--that a private group can build and operate a gaseous diffusion plant. However, because the UEA plant would likely be a last-of-its-kind, such a demonstration is not closely related to anticipated problems of other private firms planning to build enrichment plants using more advanced processes. In addition, since under the arrangements requested by UEA, its plant would operate in essentially a riskless, noncompetitive environment, little could be gained in terms of helping create a viable competitive private market.

While the UEA proposal would remove the costs of construction from the Federal budget, so would a number of other alternative arrangements, including forms of Government ownership which could have self-financing authority and the ability to borrow funds from the public.

Thus, while certain a priori arguments could be made in favor of "privatization" using the UEA method, whether one favors such action is largely a function of ones belief in the ability of the "market" to produce appropriate social results or, indeed, whether one concludes there is a "market" in this area. The single proposal for the next increment in and of itself hardly constitutes such a market. While we take no position on the appropriateness of such action, i.e., whether it is "good" or "bad," we believe that the consequences of such action should be weighed against the consequences of alternative options. In our judgment, whether to go for the privatization through the UEA proposal to build a new plant, or for the Government to add to existing plant capacity, should be judged in terms of certain basic questions: Which is the least cost? Which is most likely to succeed in providing needed capacity in a timely manner? Which is likely to allow for maximum flexibility in capacity in case assumptions or circumstances change?

Given these basic questions and the existing circumstances, we conclude that the next increment of uranium enrichment capacity should be achieved by adding on to the existing Government gaseous diffusion plants. This conclusion is based on the following considerations.

--The UEA proposal is not acceptable. Its fundamental short-coming is that it shifts most of the risks during construction and proving the plant can operate to the Government. In particular, the provision that gives UEA the option to turn the

project over to the Government if long-term financing can not be arranged, if the plant does not operate successfully during the first year, if its customers are not assured or under certain other conditions seems excessively generous. In addition, through the long-term take-or-pay contracts UEA will enter into before its accepts responsibility for the project, UEA is essentially assured a stated rate of return.

--A decision is needed now, at least on the next increment of uranium enrichment capacity, if it is to come on-line in the early 1980s when needed. Because of the technological obsolescence factors associated with the UEA plant being the last-of-its-kind facility, there is doubt as to whether it will accept much less in the way of Government assurances and guarantees than those included in its existing proposal. Further negotiations would only add to the delay in the decision of proceeding with additional capacity as soon as possible.

--In any case, there is a greater potential for slippage in the UEA schedule for bringing additional capacity on-line. On balance, we believe that problems which could occur in (1) licensing of the new facility, (2) obtaining of electric power to run the facility and the related licensing of any required nuclear powerplants, and (3) obtaining the required capital investment, outweigh any similar problems which would be faced in adding capacity to existing plants.

--Additions to existing plants can be done at an estimated construction cost of \$2.1 billion as compared to the estimated cost of constructing a UEA stand-alone plant of \$2.7 billion.

--An add-on can be phased in increments thereby keeping additional gaseous diffusion capacity at the minimum consistent with the development of centrifuge technology, and maximizing flexibility to deal with problems of changing demands or poor projections.

--We believe that management of the Government enrichment facilities could be more effectively accomplished by a corporation having a self-financing authority to borrow funds from the

Treasury or the public. Such a corporation could operate on a business-like basis and not be subject to possible conflicts with other programs in ERDA for funds and management attention. Moreover, a self-financing proposal would free the corporation from the budgetary requirements to seek congressional approval of appropriations, thereby achieving a major goal sought by the present legislative proposal.

If, notwithstanding the foregoing, Congress wishes to pursue the construction of a new free-standing facility by UEA, the deficiencies of the existing UEA proposal should be corrected in a time frame which enables construction to begin on schedule. The renegotiation should focus on UEA's options, entitlements, and risks.

We have deliberately separated the issue of the next increment from the questions surrounding additional future capacity. While the issues are presented in the present legislative proposal as a package, they are clearly separable. Our analysis yielded no areas in which a decision not to proceed with the UEA proposal would preclude actions to encourage a competitive private industry for future capacity using centrifuges and other advanced technologies. The greater industry interest in centrifuge operations is an encouraging sign.

Regarding future increments in uranium enrichment capacity, research and development efforts in advanced enrichment technologies such as gas centrifuge and laser isotope separation offer potential for more efficient enrichment of uranium. Gas centrifuge also offers the potential for involvement of more private firms because it can be built in smaller increments which require less capital. Even using advanced technologies, however, competition will be limited because (1) the capital investment required is still large (about \$1 billion), (2) the Government will likely continue to control the technology, and (3) the firms which have indicated an interest in the process have also indicated that customers are required to take a set amount of production.

We believe that ERDA should seek and encourage private industry to continue efforts in advanced technologies through explicit programs. We recognize that Government assistance and assurances will be required. In working to get private industry involved, however, the Government should seek a more equitable sharing of risk by the private enrichers and the Government than is contained in the UEA proposal. In any event some form of Government assurances and guarantees,

similar to those in the proposed Nuclear Fuel Assurance Act, will be needed.

MATTERS FOR CONSIDERATION BY THE
JOINT COMMITTEE ON ATOMIC ENERGY

The Joint Committee on Atomic Energy should consider:

- Authorizing ERDA to construct the next increment of the enrichment capacity utilizing the proven enrichment process.
- Establishing a Government corporation with self-financing authority to manage the Government's uranium enrichment facilities.
- Developing legislation with provisions similar to those in the proposed Nuclear Fuel Assurance Act authorizing ERDA to enter into corporative agreements with private enrichers using advanced technologies.

CHAPTER 6

SCOPE OF REVIEW

Our review was made primarily at ERDA headquarters in Germantown, Maryland, and was directed toward analyzing (1) the proposed Nuclear Fuel Assurance Act of 1975, (2) the May 30, 1975, proposal by UEA to build the first privately owned enrichment facility, and (3) the attendant issues that emerged from these two proposals. We obtained the information in this report by reviewing documents, reports, correspondence, and other records and by interviewing responsible officials.

In addition to discussing these matters at ERDA headquarters we met with officials of the following organizations.

- ERDA's Oak Ridge Operations Office, Oak Ridge, Tennessee,
- Nuclear Regulatory Commission, Bethesda, Maryland,
- Union Carbide Corporation, nuclear division, Oak Ridge, Tennessee,
- Uranium Enrichment Associates, San Francisco, California,
- Garrett Corporation, Torrance, California,
- Exxon Nuclear Company, Inc., Bellevue, Washington,
- Electro-Nucleonics, Inc., Washington, D.C.,
- Goodyear Tire and Rubber Company, Akron, Ohio,
- Solomon Brothers, New York, New York, and
- Kukn, Loeb, and Company, New York, New York.

FOREIGN ENRICHMENT CAPACITY

The largest enrichment capacity outside the United States is the U.S.S.R., and private sources have reported that they have a total capacity of about 7 or 8 million SWU a year. However, their total sales in 1974 to non-Communist-bloc countries is estimated at about 500,000 SWU. This number is expected to increase to about 4 million SWU in 1980. The U.S.S.R. offers contracts for spot sales as well as long-term agreements. The charge per SWU under past Soviet contracts has been about 5-percent less than the ERDA charge but is expected to approximate ERDA's from now until the 1980s.

The British and French each have a 400,000 SWU a year diffusion plant currently in operation, but the plants are soon to be shut down. The Eurodif consortium, in which France has a 42 percent interest, Italy 24 percent, Spain 12 percent, Belgium 12 percent, and Iran 10 percent, is currently building a gaseous diffusion plant. It is planned to have a capacity of 3.1 million SWU a year in 1979, 6.5 million in 1980, and 10.8 million in 1982. Eurodif contracts require only a 6-year leadtime as compared to ERDA's 8 years, but Eurodif charges a relatively higher price for each SWU. Eurodif has also planned a second diffusion plant which would have an estimated capacity of 3 million SWU a year in 1983 and 8.5 million in 1985 and increasing to 10 million SWU after 1985.

Another consortium, Urenco, was established on March 4, 1970. This is a joint venture by the Netherlands, the United Kingdom and the Federal Republic of Germany to build a gas centrifuge enrichment plant. Urenco has completed pilot plants at Almelo, Netherlands, and Capenhurst, United Kingdom, and is building demonstration plants at the same sites to be completed by 1978. They expect to have an operating capacity of about 1.4 million SWU a year by 1980 and a capacity of 10 million by 1985. Urenco's contracts require a shorter leadtime than ERDA's (only 4 to 5 years) but their charge for each SWU is now about \$100.

Other countries have planned enrichment plants for the more distant future but have not made firm commitments. For example, Japan plans to have a pilot gas centrifuge plant with a capacity of 25,000 SWU a year completed by 1978. They expect to have a fully operational plant by 1980 at an annual capacity of about 300,000 SWU which will be increased to 1 million SWU a year by 1985. South Africa has completed a pilot plant using a secret technology (probably an

aerodynamic method of isotope separation) and plans to have a 5 million SWU a year capacity by 1986. The Federal Republic of Germany is planning an enrichment plant using a jet nozzle method of isotope separation.

Several other nations and consortiums are considering building enrichment plants but have made no definite decisions. Australia would like to have a gas centrifuge plant to enrich their large supply of uranium resources to sell to Western Europe and Japan. However, Australia's prospective customers must first obtain the necessary financing, and Australia must obtain the technology to build and operate the plant. Canadif is a French and Canadian joint venture to study the feasibility of a potential gaseous diffusion plant to be located in Canada. They would like to have a 9 million SWU a year plant on line by 1985 based on U.S. or European technology and outside financing. Brinco is another Canadian-based consortium considering building an enrichment plant also based on U.S. or European technology (diffusion or centrifuge) and outside financing.

According to ERDA, Brazil has recently made an agreement with the Federal Republic of Germany under which Germany will not only sell power reactors to Brazil but also establish in Brazil the complete fuel cycle, including an enrichment plant using the jet nozzle technology. Zaire has expressed interest in some type of enrichment plant to utilize excess hydropower but, according to ERDA, so far no one has come forward to finance, build, and operate such a plant.

COMPARISON OF CURRENT
AND FORMER UEA PROPOSALS

On December 23, 1974, UEA submitted its first proposal to the Atomic Energy Commission for Government assistance to build an enrichment facility. The current May 30, 1975, proposal retains many of the same requests, such as:

- Supplying essential components to UEA.
- Providing technical assistance and know-how on the installation and operation of the gaseous diffusion process.
- Assuring that the plant will operate successfully.
- Assuring domestic partners that the Government will assume all liabilities and obligations, if UEA cannot successfully complete the plant.

There are some major differences. According to ERDA, the first proposal could have exposed the Government to a larger obligation. This would have occurred because of the proposition that ERDA would assume obligations defaulted by U.S. utilities. ERDA's obligation was to have continued for the remaining period of the utilities' 25-year contract, until the enrichment services were sold to the other customers or the domestic portion of UEA's debt had been retired, whichever was earlier.

Another request that is no longer in the current proposal was that the Government arrange to terminate enough long-term contracts with utilities to insure UEA that it would effectively sell all of its product. ERDA stated that it will accept a customer's request for termination of their contract at no cost if the customer makes a firm commitment to a domestic supplier for those services. This would be done to the extent that the commitments so terminated are beyond those which ERDA can sustain at desirable future operating conditions.

The original request also proposed that the Government obligate itself, by either guaranteeing bonds or providing direct funds to UEA, to guarantee the completion of the project. This would have occurred when a substantial cost overrun took place and UEA was unable to obtain additional funds from participants or lenders. This has been replaced by the transfer of ownership assurance.

The following table summarizes the differences in the two proposals.

COMPARISON OF THE TWO UEA PROPOSALS
FOR GOVERNMENT ASSISTANCE

<u>December 1974</u>	<u>May 1975</u>
Supply components at reasonable charges.	Supply components at Government's cost.
Provide technical assistance at reasonable charges.	Provide technical assistance at cost.
Guarantee that ERDA-manufactured items and processes will operate as expected.	No change.
ERDA obligation to complete plant without reference to time of obligation.	Transfer of ownership.
UEA access to ERDA stockpile of 11 million SWU during the early year.	UEA access to ERDA stockpile up to 9 million SWU, decreasing to 0 after 5 years.
Purchase of 5 to 10 million SWU from UEA over the first 3 to 5 years.	Purchase up to 6 million SWU from UEA during first 5 years.
Termination of ERDA enrichment contracts.	Withdrawn.
Assumption of defaulting utility obligations.	Withdrawn.

AGENCY COMMENTS AND
GAO EVALUATION

In a letter dated October 14, 1975, the Administrator of ERDA commented on a draft of this report. Presented below is the text of the Administrator's letter along with our evaluation.

ERDA Comment

"Dear Mr. Staats:

Thank you for the opportunity to review and comment on your draft report on the expansion of uranium enrichment capacity in the United States. As indicated in the President's June 26, 1975, message to Congress, this matter is of great importance to the Nation.

The President's proposal was designed to:

- . Make clear immediately our National commitment to provide the needed increase in U.S. capacity to produce enriched uranium for domestic and foreign nuclear power plants.
- . Retain U.S. leadership as a supplier of services and technology for peaceful uses of nuclear energy.
- . Assure early creation of a private competitive uranium enrichment industry -- ending the Government monopoly.
- . Accomplish the above with little or no cost to taxpayers and with all necessary controls and safeguards.

In contrast to the President's proposal, the GAO draft report concludes that (a) ERDA should reject the proposal received from the private firm that wishes to build a gaseous diffusion plant, (b) the Government should build and own the next increment of needed capacity, and (c) that a Government Corporation should be created to take over existing and the next new capacity."

GAO Evaluation

No comment required.

ERDA Comment

"We believe the most complete, accurate and objective possible analysis and presentation of the problems, issues, and alternatives is necessary to increase public understanding of the President's proposal and to provide the basis for early Congressional action on that proposal. However, as detailed below, the presentation, analysis and evaluation in your draft report is not sufficiently complete, accurate or objective to sustain its conclusions."

GAO Evaluation

We disagree that the report is not sufficiently complete, accurate or objective to sustain its conclusion. Our detail evaluation of the specific points ERDA made in support of its position are discussed under each of the appropriate sections containing ERDA's substantive reservations.

ERDA Comment

"We believe the report should be improved substantially because it:

- . Does not address fully the President's proposal."

GAO Evaluation

We clearly recognize that the Administration's proposal is aimed at including a number of firms in the uranium enrichment field. This point was also made as one of ERDA's substantive reservations and is discussed in more detail under appropriate sections below.

ERDA Comment

"Contains factual inaccuracies or misinterpretations."

GAO Evaluation

We have considered and revised as appropriate, sections of the draft report to reflect ERDA's concerns.

ERDA Comment

"Omits important considerations which, if taken into account, would lead to different conclusions."

GAO Evaluation

We do not agree. We believe that the report fairly considers all relevant factors of the Administration's proposed Nuclear Fuel Assurance Act and of the UEA proposal. Our evaluation of ERDA's substantive reservations relating to this point are discussed in the appropriate sections below.

ERDA Comment

"Reflects philosophic preferences (e.g., for a Government Corporation) rather than an objective evaluation of the many considerations involved."

GAO Evaluation

We disagree with this statement. We recognize that while certain a priori arguments could be made in favor of "privatization" using the UEA method, whether one favors such action is largely a function of one's belief in the ability of the "market" to produce appropriate social results or, indeed, whether one concludes there is a "market" in this area. The single proposal for the next increment in and of itself hardly constitutes such a market. In our judgement, whether to go for the privatization through the UEA proposal to build a new plant, or for the Government to add to existing plant capacity, should be judged in terms of certain basic questions: Which is the least cost? Which is most likely to succeed in providing needed capacity in a timely manner? Which is likely to allow for maximum flexibility in capacity in a timely manner? Which is likely to allow for maximum flexibility in capacity in case assumptions or circumstances change?

Given these basic questions and the existing circumstances, we conclude that the next increment of uranium enrichment capacity should be achieved by adding on to the existing Government gaseous diffusion plants.

ERDA Comment

"Does not emphasize the urgency of a decision expanding the Nation's uranium enrichment capacity -- which is important to our international leadership in nuclear energy and our non-proliferation objectives."

GAO Evaluation

Our conclusion that the Government should provide the next increment of capacity is based, in part, on the fact that a prompt decision is needed, on the next increment of uranium enrichment capacity if it is to come on line in the early 1980's when needed. We agree with and support the Administration's position that such a decision now, is extremely important to maintaining this nations' international leadership in nuclear energy and in our non-proliferation objectives.

ERDA Comment

"Briefly, our major substantive reservations about the report are summarized below. Each of these points is discussed further in Attachment A and detailed page-by-page comments on the draft report are included in Attachment B."

GAO Evaluation

Our evaluation of ERDA's substantive reservations about the report are presented below. We considered ERDA's detailed comments on the draft report and where we felt it appropriate, revisions were made.

ERDA Comment

"The draft report is almost exclusively limited to a discussion of a proposal (still under negotiation) from one industrial group -- Uranium Enrichment Associates -- UEA, almost to the exclusion of an evaluation of the President's total program which would cover a number of cooperative agreements with firms that wish to build plants using diffusion and centrifuge technology in the transition to a private competitive industry."

GAO Evaluation

In our view the report clearly recognized that the Administration's proposal is aimed at including a number of firms in the uranium enrichment field with either the existing gaseous diffusion technology, centrifuge, or other advanced technologies.

In addition, the report also recognizes that the UEA proposal is still under negotiation. Our discussions

focus on the UEA proposal as it currently exists because (1) the Chairman, Joint Committee on Atomic Energy, requested us to make such an evaluation and (2) it was the only proposal that ERDA had under consideration at the time of our review. In addition, if the proposed legislation is enacted, ERDA's negotiations with UEA could conceivably be completed shortly thereafter and the proposal could serve as a precedent for negotiations on future proposals submitted by other private firms.

An ERDA official told us that negotiations with UEA were still a long way off from producing a mutually agreeable proposal; however, UEA told us that negotiations were proceeding well and have already produced a mutually satisfactory interim agreement and material advancement has been made in the formulation of and definition of the issues of the long-range contract.

Because the UEA proposal once negotiated could serve as a precedent in negotiations with other private firms and because of the progress being made toward a mutually acceptable proposal, we feel it important to provide the Joint Committee on Atomic Energy as much insight as possible on the strengths and shortcomings of UEA's proposal.

ERDA Comment

"The draft report does not reflect a clear understanding of the remaining uncertainties in centrifuge technology or the role that both technologies can play in sequence in achieving a private competitive industry."

GAO Evaluation

This report explains that ERDA has been carrying out research on the gas centrifuge process since 1960 and that a pilot plant had been constructed to proof test the design and operation of a centrifuge enrichment plant. The report also explains that uncertainties exist as to the rate of machine replacement and repair costs and that the main question concerning the centrifuge process is whether it can operate at a cost as low as or lower than the gaseous diffusion process. Also, we recognized that building and operating the UEA plant with Government assistance would demonstrate the Government's commitment to "privatization" of the enrichment industry. It should be pointed out that in our discussions with officials of ERDA, its contractors, and private firms interested in building centrifuge plants,

there was virtually complete agreement that the centrifuge process would be used for future increments of capacity.

ERDA Comment

"The report does not seem to recognize that following its conclusions may prevent ever achieving a private competitive uranium enrichment industry -- even though it professes to support that objective."

GAO Evaluation

We do not agree that our conclusions would discourage private industry from entering the uranium enrichment field. While we do not favor the adoption of the UEA proposal, we strongly support ERDA's efforts to seek and encourage private industry to continue efforts in advanced technologies through explicit programs. In addition, we fully support enactment of legislation, similar to the Nuclear Fuel Assurance Act, which would provide some form of government assurance and guarantee to private firms wishing to build enrichment plants using the centrifuge or other advanced technologies. On October 1, 1975, CENTAR Associates submitted a proposal to ERDA to construct an enrichment plant using the centrifuge process. CENTAR officials told us that their proposal requested forms of government assistance and offers to accept degrees of risk different from those UEA is proposing.

Two other private firms also have recently submitted proposals to ERDA to construct enrichment plants using the centrifuge process.

This interest indicates to us that private firms would be willing to enter the enrichment field using advanced technologies regardless of whether or not the UEA proposal is accepted.

ERDA Comment

"The report (a) understates the risks to be assumed by private firms that are contemplated in the President's proposal, (b) understates the risks to UEA and its proposal, and (c) overstates the potential risks and costs to the Government."

GAO Evaluation

The draft report clearly sets forth the risks and uncertainties identified by the four potential private enrichers and explains that some Government cooperation or assurances are needed to attract financing because of the risks and uncertainties associated with constructing and operating a private enrichment facility. The report lists such risks and uncertainties as

- classified technology;
- no commercial experience;
- large capital requirements and long payback periods;
- licensing uncertainties;
- potential nuclear moratorium; and
- weak financial condition of many utilities.

The report points out that the Government take over provision will expire about one year after successful commercial operation and UEA access to ERDA's stockpile of SWU expires after five years. With the expiration of these assurances, UEA will be assuming the risks associated with operating its plant. However, the greatest risks occur during the construction and initial operating period. UEA's 25-year contracts based on a pass through pricing concept act to minimize the risks involved in operating the plant.

The proposed legislation provides that UEA risks losing its domestic equity to the Government in the event of gross mismanagement, gross negligence, or willful misconduct by UEA. The burden of proof will be on the Government. It is difficult for us to visualize any circumstances where the Government could prove gross mismanagement, gross negligence, or willful misconduct, because the Government will be involved in providing UEA with technical assistance, design assistance, personnel training, enrichment process review, potential supplier evaluation, and component testing. A partial return of equity could occur depending on UEA's compliance with its commitments, the efforts of UEA and the degree of fault.

The report explains that the forms and degree of assistance provided private firms would be at the discretion

of the ERDA Administrator. The proposed legislation includes, but is not limited to such assistance and assurances as

- furnishing technical assistance, information, inventions and discoveries, enriching services, materials, and equipment on the basis of recovery of costs;
- guaranteeing the quality of Government-furnished equipment and materials;
- assuring the facility will perform successfully;
- purchasing separate work units from the private enrichment plant;
- buying the assets or interest of any U.S. citizen or organization owned or effectively controlled by U.S. citizens in any enrichment plant, and assuming their obligations and liabilities, if private industry cannot finish or bring the plant into commercial operation; and
- modifying, completing, and operating the plant as a Government facility, or disposing of the plant.

The report states that the Government's potential financial commitment includes (1) reimbursing domestic participants if UEA is unable to complete the project and (2) purchasing up to 6 million SWU from UEA. The proposed legislation authorized ERDA to enter into an unlimited number of contracts with private firms but imposes an \$8 billion limit on the total potential cost to the Government in the event all private ventures covered by cooperative agreement were to fail. The report also states that ERDA does not expect this to happen but believes the legislation is necessary to assure customers and the financial community of the Federal Government's commitment.

ERDA Comment

"The report does not analyze objectively its strong recommendation that a Government corporation be created to provide uranium enrichment services -- which corporation would have many of the same drawbacks as direct government financing."

GAO Evaluation

The draft report states that a Government corporation should be created to own and operate the three existing Government enrichment facilities and provide the next increment of capacity and that ERDA should seek and encourage private industry to furnish succeeding increments through explicit programs. Because it is likely that private firms offering to build such capacity will require some form of Government assurances and guarantees, provisions similar to those in the proposed Nuclear Fuel Assurance Act will be needed.

We reached this position after our analysis concluded that (1) the UEA proposal is not acceptable because of the negligible risk borne by UEA, (2) further negotiations are not likely to result in a more equitable sharing of risks, and (3) the present ERDA-run enrichment operation could be improved upon and that a Government corporation would be a desirable method of more nearly placing the enrichment operation on a businesslike basis.

The report states that while the UEA proposal would remove the costs of construction from the Federal budget, other forms of Government ownership with self-financing authority and the ability to borrow funds from the public would accomplish the same objective. Freedom from competing for funds with other ERDA programs would permit a Government corporation to operate enrichment activities on a more businesslike basis than the present ERDA-run operation.

ERDA Comment

"The discussion of cash flow and Government financing is inaccurate and misleading in that it (a) does not make clear the large budget outlays that would result over the next few years if the Government builds new capacity; (b) incorrectly implies that the costs of a new add-on Government plant would be recouped in about 6 years; and (c) confuses revenue from existing plants and eventual revenue from a new add-on Government plant. The revenue from existing plants is largely a repayment for past and current costs to taxpayers for building and operating these plants."

GAO Evaluation

We recognize that the draft report was somewhat unclear regarding whether our discussion of cash flow related to

the Government add-on or to the add-on and existing enrichment facilities. We made editorial changes to clearly point out that ERDA estimates that revenues generated by the existing plants and the add-on would exceed costs by about \$8.3 billion by the year 1990. It should be noted that while the UEA proposal would remove the costs of construction from the Federal budget, so would other forms of Government ownership having self-financing authority and the ability to borrow funds from the public.

ERDA Comment

"The statement that Government-owned capacity could be added at a cost significantly less than that of a similar sized privately-owned plant ignores the broader benefits of private financing and ownership of uranium enrichment plants including the possibility of attracting some \$2 billion in foreign capital for the UEA plant."

GAO Evaluation

In our judgement, the report clearly addresses the benefits of private financing and ownership of uranium enrichment plants. While we agree that private financing would have a favorable budgetary impact, so would a number of other alternatives, including forms of government ownership which would have self-financing authority and the ability to borrow funds from the public. If desired, we see no reason why the Government could not solicit foreign investments in building additional enrichment capacity.

ERDA Comment

"While an early decision on the approach to expansion of U.S. capacity is essential to maintain the credibility of the U.S. and a reliable supply source, a delay of one year or two -- beyond the UEA planned date for having a plant on line -- would not present serious problems. Furthermore, although a half-sized, Government-owned add-on plant could be completed by the beginning of 1984, a plant equivalent in capacity to the proposed UEA plant could not be brought on line until at least 18 months after the presently scheduled date for UEA plant completion (mid-1983)."

GAO Evaluation

We recognize in the report that the immediacy of when additional enrichment capacity is needed can not be stated with certainty. We agree with ERDA that cancellations in nuclear powerplant orders, slippages in plant on-line dates, and the Government's stockpile of enriched uranium gives the nation some flexibility in accomodating schedule slippages in construction of enrichment plants by either the Government or industry.

If successfully demonstrated, providing additional capacity using the centrifuge process offers the potential for enriching uranium at a fraction of the electrical energy needed using the gaseous diffusion process. Conservation of all forms of energy, including electrical energy is a major goal in this country today. Thus, the flexibility that ERDA has pointed out could also be used to "buy time" until the more efficient centrifuge process can be developed. ERDA's recognition of this flexibility adds greater significance to our conclusion that an add-on can be built in increments thereby keeping additional gaseous diffusion capacity at the minimum consistent with the development of centrifuge technology. This approach would also maximize flexibility to deal with the problems of changing demands or poor projections.

Further, a delay by UEA in getting its plant on line--depending on the length of time involved--could (1) place a greater dependence on the Government's stockpile to meet UEA's customer requirements, and (2) increase UEA's costs, which in turn would increase the Government's outlays in the event of a Government takeover.

ERDA Comment

"The criticism in the draft report of private ventures' plans to obtain long-term 'take-or-pay' contracts for enrichment services, and implied criticism of not providing the uranium which is to be enriched, suggests that GAO may not recognize current, widely accepted practices. 'Take-or-pay' contracts are now used by ERDA in selling services from existing plants and are often used in industry -- for example by utilities in purchasing coal."

GAO Evaluation

The report stated that ERDA now uses and other private enrichers--in addition to UEA--are expected to use "take-or-pay" contracts. Our discussion of UEA's plans to use "take-or pay" contracts was intended to show the interaction between the contracts and risk and should not be characterized as criticism. Similarly, our discussion of the utilities' being responsible for providing the uranium to be enriched and how that proposed arrangement interacts with risk should not be characterized as implied criticism.

ERDA Comment

"The criticism of private ventures' slowness in signing up foreign customers suggests a lack of understanding of the impact of the uncertainty while Congressional action is awaited, and the positive effect that early Congressional approval would have."

GAO Evaluation

The report recognizes that UEA is having difficulty securing foreign participation and that the uncertainty regarding the U.S. Government position on the project was a possible cause for this situation. It seems reasonable to us that there should be more certainty about the expected foreign participation before ERDA places itself in a position to accept a proposal for a project which is dependent on foreign investment.

ERDA Comment

"The report is correct in concluding that the safeguarding of nuclear materials and protection of classified technology is not an issue in the debate over Government vs. private ownership of a plant. However, we believe the report should emphasize that prompt action toward expanding the Nation's uranium enrichment capacity would be a major contribution to continued U.S. technological leadership and to non-proliferation objectives."

GAO Evaluation

The report essentially contains the information ERDA believes should be emphasized. We state that it is important for the United States to maintain as much of the foreign

market as possible to (1) maximize our balance of payments position, (2) obtain the commitment of additional nations to accept the principle of nuclear nonproliferation, and (3) cooperate with other major oil-consuming nations which are looking to nuclear power to help reduce their dependences on foreign oil imports. We stated further that the longer this country delays in constructing new enrichment capacity, the worse our position will be in competing for foreign customers. Also we recognized that sales of enrichment services have been used as leverage to obtain safeguards and non-proliferation guarantees.

ERDA Comment

"We urge strongly that the General Accounting Office proceed promptly with the correction and completion of its report so that it will not contribute further to delay in Congressional action on the President's proposal. We believe it is essential that a National decision on the means for expanding U.S. capacity to enrich uranium be reached without further delay.

We are prepared to cooperate fully in providing any additional information and assistance that you might need in completing your report.

Sincerely,

Robert C. Seamans, Jr.
Administrator"

AN EQUAL OPPORTUNITY EMPLOYER

UNITED STATES
GENERAL ACCOUNTING OFFICE
WASHINGTON, D.C. 20548

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE, \$300

POSTAGE AND FEES PAID
U. S. GENERAL ACCOUNTING OFFICE



THIRD CLASS