

GAO

Report to Congressional Requesters

October 1987

URANIUM ENRICHMENT

Congressional Action Needed to Revitalize the Program



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United States
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Resources, Community, and
Economic Development Division

B-207463

October 19, 1987

The Honorable William Proxmire
United States Senate

The Honorable Gordon J. Humphrey
United States Senate

The Honorable Philip R. Sharp
Chairman, Subcommittee on Energy and Power
Committee on Energy and Commerce
House of Representatives

This report responds to your requests to assess the problems of the Department of Energy's uranium enrichment program and identify options to revitalize it. The report includes recommendations to the Congress directed toward changing the program in light of the current business environment.

Unless you publicly announce its contents earlier, we plan no further distribution of this report until 30 days from the date of this letter. At that time we will send copies of this report to other interested committees and members of the Congress; the Director, Office of Management and Budget; and the Secretary of Energy. Copies will be made available to others upon request.

This work was performed under the direction of Mr. Keith O. Fultz, Associate Director. Other major contributors are listed in appendix III.

J. Dexter Peach
Assistant Comptroller General

Executive Summary

Purpose

Many problems, including multibillion-dollar payments for electricity not needed, billions of dollars of unrecovered government costs, uncertain decommissioning and environmental costs, and ongoing litigation, are seriously hampering the Department of Energy's (DOE) ability to supply competitively priced enriched uranium to nuclear utilities. In response to requests from Senators William Proxmire and Gordon J. Humphrey and the Chairman, Subcommittee on Energy and Power, House Committee on Energy and Commerce, GAO assessed these problems and identified options for the future of the enrichment program.

Background

Uranium enrichment is the process that prepares uranium ore for use as nuclear reactor fuel. In 1969 the government began enriching uranium for the growing commercial nuclear power industry. The aim of the program is to promote national energy security goals by establishing a stable domestic supply while recovering government costs over a reasonable period of time. Anticipating a growing demand for enriched uranium, DOE's predecessor agencies expanded production capacity and signed long-term contracts with the Tennessee Valley Authority (TVA) to supply the large amounts of electric power required by the enrichment plants.

Beginning in the early 1980s, DOE's sales did not reach expected levels because the growth in demand for nuclear power slowed drastically. Further, foreign competitors had taken over almost half of DOE's once exclusively held market. In 1984, facing rapidly rising costs and a steadily declining customer base, DOE began taking a number of steps to recover its market position and cut costs. For example, DOE offered new contracts to nuclear utilities with lower prices based on a proposed write-off of past costs, cancelled a new production plant, closed down an existing plant, and began selling off existing inventories. (See ch. 1.)

Results in Brief

The DOE uranium enrichment program is beset by numerous problems that have left it facing a bleak financial future. The problems include \$8.8 billion in unrecovered costs, multibillion-dollar payments for unused TVA power, market uncertainties due to ongoing litigation, and potentially large decommissioning costs. If these problems and the future of an advanced laser enrichment technology are not resolved, the program is likely to enter a downward spiral resulting in further costs and customer losses. Potential steps include writing off past costs associated with unproductive assets and/or allowing DOE more price flexibility.

DOE has proposed that the Congress form a federally chartered corporation, which it believes will facilitate the management of enrichment activities in a competitive manner. Regardless of whether the program remains in DOE, GAO believes that the Congress needs to take steps to address its specific problems in order to ensure the program's future.

Principal Findings

Many Problems Affect the Program

DOE faces aggressive foreign competition, which had captured about 50 percent of the world market by 1986. Although its market share has declined, DOE's costs have increased largely because of growing payments for electricity not used under long-term contracts signed with TVA. In fiscal year 1985, DOE paid \$347 million for unused power and could pay an additional \$3 billion through 1994. In June 1987 DOE withheld part of the contract payments to TVA because it believes it is being overcharged. In return, TVA sued DOE. As of October 1987, the court had not rendered a decision.

DOE's enrichment program also faces uncertainties in connection with a lawsuit filed by domestic uranium miners. Under the Atomic Energy Act, DOE is required to restrict its enrichment of foreign uranium ore to the extent necessary to maintain a viable domestic mining industry. In 1984 DOE determined that the industry was not viable but took no direct action. Several producers took DOE to court to require it to enrich only domestic uranium. A lower court ruled in favor of the miners; DOE expects to appeal this decision to the U.S. Supreme Court.

Eventually, DOE will need to decontaminate and decommission its enrichment plants. This could cost over \$1 billion for each plant. DOE has not yet determined when this will occur and does not consider decommissioning costs when setting its prices. In the meantime it may cost DOE between \$179 million and \$355 million to upgrade its aging plants to comply with environmental legislation, such as the Resource Conservation and Recovery Act. (See ch. 2.)

Unrecovered Costs

The Atomic Energy Act requires that the government's costs associated with producing enriched uranium be recovered over a reasonable period of time. GAO calculates that as of the end of fiscal year 1986 DOE had not

recovered about \$8.8 billion. The Congress has before it proposals calling for recovery of all costs and as little as \$350 million. Since the existing program cannot expect to generate revenues sufficient to recover all costs, GAO believes a practical approach would be to allow DOE to write off unproductive assets. DOE formally proposed such a write-off in 1986, which would have left unrecovered costs at that time of about \$3.4 billion. Such a write-off is consistent with generally accepted accounting principles. Also, DOE believes the write-off, combined with price flexibility, would allow it to balance cost recovery objectives with other program objectives, such as national defense and energy security. (See ch. 2.)

DOE Efforts Could Threaten Competitiveness

In order to reduce current costs and meet current budget requirements, DOE has taken several actions. However, some of the actions could threaten DOE's ability to be competitive in the future. For example, DOE cut current-year production costs by meeting demand from inventories. DOE estimates that over the next 4 to 5 years this practice could increase costs by about \$80 million if DOE has to increase production later when costs are expected to be higher.

In addition, because of its financial problems, DOE did not request fiscal year 1988 funds for research on an energy-efficient laser technology under development, stating that a private firm should assume its risks and costs. However, private sector involvement in this technology is unlikely until DOE develops it further. Both the House and Senate Committees on Appropriations have approved bills anticipating a funding level of \$100 million for this program in fiscal year 1988. DOE officials believe that the program is 3 to 5 years ahead of foreign competitors and offers the best hope for the enrichment program to be cost-effective. GAO believes that this technology should be evaluated periodically in light of its costs and the risks facing the future of nuclear power. (See ch. 3.)

DOE Proposal to Form a Federally Chartered Corporation

DOE's proposal to restructure the uranium enrichment program as a federally chartered corporation would provide some needed management flexibility. However, the proposal does not address the specific program problems, or contain sufficient controls. GAO has supported the formation of corporations in circumstances similar to the enrichment program, but believes that if such a corporation is formed, it should be subject to

the Government Corporation Control Act. GAO also believes that formation of a corporation alone will do little to ensure the future of the program, unless steps are also taken to address its specific problems. (See ch. 3.)

Recommendation to the Congress

In order to place the enrichment program on firm financial footing, the Congress should enact legislation to (1) define a reasonable amount of costs to recover by allowing the write-off of unproductive assets, (2) provide the program with budget and management flexibility, (3) allow flexible pricing strategies, and (4) require the recovery of decommissioning costs.

If the Congress decides that a corporate structure would best meet the program's goals, the Congress should require it to meet the provisions of the Government Corporation Control Act. The government corporation's charter should also address the specific problems creating financial uncertainty for the program. (See ch. 4.)

Matters for Consideration of the Congress

As the Congress reviews the enrichment program, it should periodically consider the risks and costs of the ongoing laser program. In addition, it should consider the negative impact of a court decision restricting DOE from enriching foreign-mined uranium ore. It should also consider amending the Atomic Energy Act to remove the requirement that prohibits DOE from enriching foreign uranium to the extent necessary to assure the viability of the domestic uranium mining industry, or specify the amount of foreign uranium ore DOE can enrich. (See ch. 4.)

Agency Comments

GAO discussed the facts presented in this report with DOE officials. Generally, they agreed with the facts but offered some clarifications which were incorporated where appropriate. As requested, GAO did not ask DOE to review and comment officially on this report.

Contents

Executive Summary		2
Chapter 1		8
Introduction	DOE Enrichment Program Faces Many Problems	9
	Objectives, Scope, and Methodology	11
Chapter 2		13
Many Problems Affect DOE's Enrichment Program	Escalating TVA Demand Charges	13
	Unrecovered Government Costs Growing Rapidly	15
	Environmental and Decommissioning Costs for the Diffusion Plants Could Be in the Billions of Dollars	18
	Future DOE Demand Picture Is Cloudy	20
Chapter 3		24
DOE Revitalization Efforts Have Not Solved All Problems	Some DOE Efforts to Cut Costs Shortchange the Future	24
	DOE Analysis of Program Options	27
	DOE's Proposal to Restructure the Uranium Enrichment Enterprise Is Not Complete	31
	Legislative Proposals	32
	Other Options	33
Chapter 4		36
Conclusions and Recommendations	Problems Facing the Enrichment Program Need to Be Addressed	36
	DOE's Restructuring Proposal	39
	Recommendations to the Congress	39
	Matters for Consideration of the Congress	40
Appendixes	Appendix I: DOE Actions to Revitalize the Program	42
	Appendix II: Requirements for a Government Corporation	46
	Appendix III: Major Contributors to This Report	47
Tables	Table 2.1: DOE Demand Charges Paid to TVA	14
	Table 2.2: Unrecovered Government Costs of the Uranium Enrichment Program	17
	Table 2.3: DOE's 1986 Mid Case SWU Projection, Fiscal Years 1988-2000	21
	Table 3.1: DOE Enrichment Production Plan	25

Table 3.2: Treasury Cash Flows for DOE-Identified
Enrichment Scenarios

29

Abbreviations

AVLIS	Atomic Vapor Laser Isotope Separation
DOE	Department of Energy
GAO	General Accounting Office
NRC	Nuclear Regulatory Commission
SWU	separative work unit
TVA	Tennessee Valley Authority

Introduction

Uranium enrichment is the process that prepares uranium ore for use as nuclear reactor fuel and for defense applications. During the 1940s and 1950s, the United States built three gaseous diffusion uranium enrichment facilities at Oak Ridge, Tennessee; Paducah, Kentucky; and Portsmouth, Ohio, to produce enriched uranium for defense purposes.¹ In 1964 the Congress amended the Atomic Energy Act of 1954, establishing a uranium enrichment program beginning in 1969 that would use the same facilities to meet the growing needs of the commercial industry.

When the United States began providing enriched uranium to commercial nuclear power plants in 1969, it was the only free-world supplier of commercial enrichment services. Forecasts of rapidly growing demand for nuclear power led to the gradual expansion of enrichment capacity at the three diffusion plants to about 27 million separative work units (SWU)² by 1983. However, demand for U.S. enrichment services was so high in 1974 that the Atomic Energy Commission, a predecessor to the Department of Energy (DOE), would not accept any additional orders because all existing capacity was firmly committed. Because demand was so high, the Congress in 1975 authorized the Commission's successor—the Energy Research and Development Administration—to construct new enrichment capacity at Portsmouth, Ohio. DOE decided to build a gas centrifuge enrichment plant to supply this capacity because projected electric power costs were lower than for the gaseous diffusion technology.³

After the Commission refused to take any further orders, the United States lost its monopoly in the uranium enrichment market when two European consortiums and the Soviet Union began supplying foreign nuclear utilities with enriched uranium. By the early 1980s, these suppliers had captured about 50 percent of the total market. According to DOE officials, foreign suppliers gained access to the market because of (1) price and exchange rate differences, (2) customers' need to diversify sources of enriched uranium, and (3) more favorable contract terms.

Furthermore, in the United States, expected demand for nuclear power declined in the late 1970s. Domestic electric utilities have cancelled

¹The gaseous diffusion technology is a repetitive process that separates uranium hexafluoride gas into two streams; one stream has a higher content of fissionable material.

²A separative work unit (SWU) is a measure of the effort required in a uranium enrichment plant to separate uranium into two components.

³The centrifuge technology is a repetitive process that uses large centrifuge machines to separate the fissionable material in uranium.

orders for over 100 nuclear power plants since then. Because of these cancellations, related construction delays, and long-term DOE contracts that required utilities to accept enriched uranium or pay a penalty, customer-held inventories of enriched uranium increased significantly. A secondary market, where enriched uranium was sold by oversupplied utilities at discounted prices, emerged.

This changing market environment led to a steady deterioration of the U.S. uranium enrichment program. From 1974 to 1985 DOE lost about \$5 billion in enrichment sales. Approximately 70 percent of this loss was due to customers who terminated their contracts with DOE to sign with foreign suppliers; the remaining 30 percent was attributable to customers who terminated in order to take advantage of lower prices in the secondary market.

As a result of this significant loss of enrichment business, the Secretary of Energy in June 1984 appointed a Process Evaluation Board to evaluate the gas centrifuge and atomic vapor laser isotope separation (AVLIS)⁴ technologies. The board determined that the AVLIS technology had the better potential for low-cost, reliable production of enriched uranium in the future. As a result of the board's findings, DOE cancelled construction of the gas centrifuge plant in 1985 after having spent approximately \$3.5 billion (including interest expense) on its development.

DOE Enrichment Program Faces Many Problems

The uranium enrichment program faces an uncertain financial future because of many problems. These problems, such as high charges for unused electricity, have prevented DOE from recovering costs from revenues as required by the Atomic Energy Act. For example, in fiscal year 1986, DOE's revenues were about \$1.24 billion, but its costs totaled about \$1.55 billion.

DOE's total unrecovered costs are now accumulating at the rate of about \$1 billion per year, largely because of imputed interest⁵ on the unrecovered balance. We calculated that at the end of fiscal year 1986 these costs were about \$8.8 billion, up from about \$7.8 billion the year before. DOE formally proposed in 1986 to recover only about \$3.4 billion of these

⁴The experimental AVLIS technology enriches uranium by charging the fissionable material in it with a laser beam and collecting it on a large magnetic separator. See ch. 2 for a more detailed discussion on the AVLIS process.

⁵Imputed interest is an established interest cost (representing the cost of U.S. Treasury borrowings) assigned to a particular government investment alternative, even though actual interest expenditures may not be incurred by the agency undertaking the activity.

costs and has restructured its pricing policy to accomplish this over the next 10 years. In the Continuing Appropriations for Fiscal Year 1987, the Congress reserved the right to determine how much DOE should return to the Treasury. (We discuss this issue in greater detail in ch. 2.)

Perhaps the biggest impediment to DOE's ability to operate the program in a fiscally sound manner is the multi-billion dollar charges for electricity from the Tennessee Valley Authority (TVA) that it contracted for early in the program but no longer needs. Since 1981, the costs for unused TVA power under the existing contracts have increased to a level where they now constitute the largest single cost after imputed interest charges for the enrichment program. Through fiscal year 1986, DOE paid about \$1.3 billion for unused power; for fiscal year 1987, DOE estimates that these charges will be about \$511 million—42 percent of its total non-interest program costs. From fiscal year 1988 through March 1994 when the contracts end, DOE projects it will pay an additional \$2.5 billion for unused power to TVA.

In June 1987 DOE, contending that TVA established excessively high rates, withheld part of its monthly payment under the contracts and announced its intention to pay only 50 percent of the charges beginning in October 1987. TVA responded by petitioning the U.S. District Court in Knoxville, Tennessee, for an injunction that would prevent the withholding of any amounts due under the contracts. In August 1987 the district court transferred the case to the U.S. Court of Claims. As of September 1987, that court had not acted on TVA's lawsuit.

DOE also faces uncertainties because of another lawsuit. In December 1984 domestic uranium miners sued DOE to, in part, restrict it from enriching foreign uranium. In July 1987 the U.S. Court of Appeals for the Tenth Circuit ruled that DOE must restrict its enrichment of foreign uranium in order to support the domestic mining industry. In November 1987 DOE plans to petition the U.S. Supreme Court to review the Court of Appeals decision. DOE believes that if the lower court's rule stands, it could lose a significant amount of business as its customers terminate their DOE enrichment contracts and obtain foreign ore and enrichment services elsewhere.

Objectives, Scope, and Methodology

On November 12, 1986, Senators William Proxmire and Gordon J. Humphrey requested that we evaluate several issues associated with DOE's enrichment program. On March 18, 1987, the Chairman, Subcommittee on Energy and Power, House Committee on Energy and Commerce, made a similar request. On the basis of discussions with the requesters' staffs, we agreed to identify and assess (1) the problems of the existing program, including the escalating unrecovered government costs and TVA demand charges, (2) steps DOE has taken to revitalize the program, and (3) strategies to address these problems.

To obtain information relative to each of these issues, we interviewed DOE uranium enrichment program officials in Germantown, Maryland, and at the Oak Ridge Operations Office, Oak Ridge, Tennessee. We also spoke with representatives of the Office of Management and Budget and the Nuclear Regulatory Commission (NRC). We obtained the private sector's views from officials of the American Enrichment Company, the Edison Electric Institute, the Atomic Industrial Forum (now called the U.S. Council for Energy Awareness), the National Association of Regulatory Utility Commissioners, and representatives of the domestic uranium miners industry. In addition, we also talked with representatives of one of DOE's major foreign competitors, Urenco, to determine its plans to build an enrichment plant in the United States. We also met with Lawrence Livermore National Laboratory officials conducting research and development on the AVLIS program. We did not, however, evaluate the AVLIS program to determine if its expected costs are appropriate in view of the risks associated with the future of nuclear power.

To further identify the enrichment program's existing and long-term problems, we examined DOE strategy and operating plans, annual reports, demand studies and forecasts, draft decontamination and decommissioning plans, and the TVA/DOE power contracts and analysis related to the contracts. We did not determine the validity of the TVA contract charges because this activity was outside the scope of our review. However, we did review studies that assessed the impacts on the program of foreign uranium ore restrictions and the domestic uranium mining industry lawsuit.

To identify various DOE program revitalization efforts, we examined the Oak Ridge diffusion plant standby plans, power plans for the gaseous diffusion plants, and testimony concerning cost write-offs. Further, we reviewed a number of DOE utility service contracts to determine how DOE defines prices and structures termination clauses. We also examined DOE's AVLIS program reports that project completion costs and milestones.

We did not evaluate the legal authority for any of DOE's revitalization efforts.

As a result of our analysis of this information, we identified various options to revitalize the program. In addition, we reviewed documents proposing various organizational structures and studies directed at the privatization of the uranium enrichment enterprise. These included DOE's draft report on the advantages of a federally chartered corporation, the interim and final proposals to the Congress recommending a change in structure, and an Office of Management and Budget report on government corporations. Although we did not verify DOE's analysis of the enrichment market, we did compare DOE's proposal to form a uranium enrichment corporation with the criteria for new government corporations contained in our General Policy Manual.

We also examined the results of DOE's solicitation of private interest in the program and the American Enrichment Company's proposal to use existing gas centrifuge facilities and DOE's analysis of the proposal. In addition, we reviewed several DOE market scenarios that were analyzed by a computer model developed by the Lawrence Livermore National Laboratory. The analysis considered various technological alternatives and calculated potential returns to the government and/or private investors. However, we did not assess commercial customers' reactions to increased or decreased prices for enriched uranium or determine the accuracy of DOE's analysis of organizational structures and associated cash flows. The time and resources to do so were outside the scope of this review.

We attended a May 1987 conference, The Enrichment Marketplace of the 1990s, sponsored by the U.S. Council for Energy Awareness. The conference provided additional insight on many areas pertaining to uranium enrichment, including worldwide supply and demand. In addition, we attended a July 1987 U.S. Council for Energy Awareness meeting on the future of the uranium enrichment program. We also visited the Oak Ridge gaseous diffusion plant and centrifuge facilities.

We discussed the facts presented in the report with officials within DOE's Office of the Deputy Assistant Secretary for Uranium Enrichment. Generally, they agreed with the facts but offered some clarifications that were incorporated where appropriate. As requested, we did not ask DOE to review and comment officially on this report. We conducted our work between December 1986 and July 1987 in accordance with generally accepted government auditing standards.

Many Problems Affect DOE's Enrichment Program

The future of DOE's uranium enrichment program is uncertain because of its many problems. These include multimillion-dollar demand charges for unused power under take-or-pay contracts signed with TVA in the early years of the program and unrecovered government costs totaling about \$8.8 billion. In addition, DOE's enrichment program is facing a troubled financial future because of estimated high costs to (1) upgrade its aging gaseous diffusion plants to comply with environmental legislation and (2) ultimately decontaminate and decommission the plants.¹ DOE tentatively estimates that environmental compliance could cost between \$179 million and \$355 million by the year 2000 for all three plants, and costs to decontaminate and decommission each plant could reach \$1 billion. Further, the demand for DOE's enrichment services is uncertain because of increased competition and a declining nuclear power industry. DOE also faces market uncertainties because of an ongoing lawsuit filed by domestic uranium miners. Each of these problems has affected or could affect the program's ability to compete in the worldwide enriched uranium market.

Escalating TVA Demand Charges

Anticipating an increase in the demand for enrichment services, DOE's predecessor, the Atomic Energy Commission, signed two contracts with TVA in 1969 for large amounts of power to operate its Oak Ridge and Paducah enrichment plants.² Under the two contracts, DOE agreed to pay TVA certain charges, including minimum annual payments (demand charges) for unused power. The demand charges ensure that TVA recovers at least part of its facilities' construction costs to make the power available, even if DOE does not actually purchase the power. Under the contract TVA calculates demand charges and can increase the power reserved for DOE as new capacity is added to the TVA system. In addition, both DOE and TVA have the right to cancel up to 1,000 megawatts of power within any 12-month period with an 8-year advance notice.

The contracts went into effect in 1971. In 1973 and 1974 DOE modified the contracts to increase the amount of power to be supplied in light of still rising enrichment demand projections. In the mid- to late-1970s, however, DOE lost its monopoly in the world's uranium enrichment market. Foreign competition increased and demand projections declined. Further, prospects for the nuclear power industry in this country

¹At the end of their useful life, radioactively contaminated facilities must be decontaminated and decommissioned to ensure that they do not cause environmental damage.

²Paducah also obtains power from Electric Energy Incorporated. The third plant, Portsmouth, is under contract with the Ohio Valley Electric Corporation.

declined as a result of reduced growth in demand for electricity and increased concern over nuclear nonproliferation and health and safety issues.

By 1981 DOE was using significantly less power than anticipated when the contracts were signed. In December 1981 DOE first exercised the contract option to cancel up to 1,000 megawatts of power. DOE has given additional notices since 1981 that will result in reduced contract power levels beginning in 1989, and a reduction to zero by March 1994, terminating the contracts. DOE's electricity requirements continued to decline, and in 1985 DOE stopped operating the Oak Ridge uranium enrichment plant and began operating the Paducah plant primarily with cheaper electricity from another source.

Although DOE reduced its power consumption, the demand charges paid to TVA continued to escalate. In fiscal year 1981 DOE paid about \$27 million for 379 megawatts of unused reserved power. In fiscal year 1984, TVA, following an increase in production capacity, exercised its contract option and increased the power reserved for DOE. Following TVA's action, DOE's demand payments rose to about \$350 million for about 4,000 megawatts of unused power in fiscal year 1985. In May 1987 DOE projected that fiscal year 1987 payments would total about \$511 million for about 4,400 megawatts of unused power. DOE officials estimate that TVA will charge another \$2.5 billion for unused power from 1988 to 1994, when the contracts expire. They also say that such payments would severely hurt their ability to charge competitive prices. Table 2.1 shows the increases in TVA demand charges between fiscal years 1981 and 1987.

Table 2.1: DOE Demand Charges Paid to TVA

Dollars in millions		
Fiscal Year	DOE Demand Charges	Unused Power (megawatts)
1981	\$27	379
1982	111	1,370
1983	115	1,413
1984	226	2,639
1985	347	4,032
1986	434	4,390
1987 (projected)	511	4,390

DOE officials say they do not dispute the need to pay demand charges under the contracts but believe that TVA has increased these charges to

excessive levels while decreasing power rates charged to other industrial customers. DOE also believes that the demand charges are largely linked to TVA plants that will not begin producing electricity until after the contracts expire because of construction delays and other problems. TVA officials have also indicated that they could not provide the total amount of power from its existing plants if DOE needed it.

Because of what it termed a lack of progress to achieve a good faith settlement, DOE began in June 1987 to reduce its monthly payments to TVA by 10 percent. In its June 10, 1987 letter to TVA, DOE stated that starting in October 1987 it plans to pay only 50 percent of its scheduled monthly demand payment until a mutually satisfactory resolution can be reached. If DOE continues with its scheduled payments through the end of the contracts, it would pay about \$1.25 billion more to TVA. DOE offered in its June letter to submit the matter to binding arbitration. DOE said that if TVA agreed to arbitration, and if significant progress was made in such arbitration by August 1, 1987, it would suspend the scheduled reduction and continue to pay 80 percent of the monthly demand charges until the proceedings were completed.

On June 16, 1987, TVA, in response to DOE's payment reduction, sued DOE in the federal district court in Knoxville, Tennessee. TVA asked the court to declare that DOE is required to pay the rates set by TVA, and to enjoin DOE from withholding any payments. TVA argues that DOE's action violates (1) the two power contracts, (2) the TVA act which authorizes TVA to set rates, and (3) the Atomic Energy Act which TVA asserts authorizes the two contracts. On August 4, 1987, the district court declared it did not have jurisdiction and transferred the case to the U.S. Court of Claims. As of October 1987, no further action on the case had occurred.

Unrecovered Government Costs Growing Rapidly

In providing enrichment services to its customers, DOE is required by subsection 161(v) of the Atomic Energy Act of 1954, as amended, to price its services so that the government's enrichment costs will be recovered over a reasonable period of time. This pricing policy is generally referred to as the enrichment program's full-cost-recovery requirement. To recover the government's full enrichment costs, DOE's enrichment prices must recover operating and capital expenditures plus imputed interest. As of the end of fiscal year 1986, we calculated that the amount of unrecovered costs totaled about \$8.8 billion.

To make this calculation, we first determined the government's total cost of providing enrichment services. The total government cost is the

sum of (1) the government's initial investment in the program, (2) appropriations, and (3) imputed interest. The current annual interest costs were calculated by applying the current Treasury rate to the amount invested in the program. Second, we subtracted the revenues generated by the program, which represent the portion of the government cost that has been recovered, from the total government cost.

In determining the total government cost, our calculation recognizes the \$1.5 billion in costs incurred by the government to establish the enrichment program. When the program started in 1969, the government transferred an initial investment to the program of about \$1.5 billion (\$1 billion in assets and \$500 million in enriched uranium inventory) that was to be recovered in future enrichment prices. Between fiscal years 1971 and 1986, the program received about \$18.4 billion in appropriations for operating expenses and capital investment and has incurred about \$5.5 billion in imputed interest expense. Thus, the total government cost subject to the program's cost recovery requirement, including the government's initial investment, has been about \$25.4 billion. According to the enrichment program's financial statements, the government has recovered about \$16.6 billion of these costs in revenues, leaving an unrecovered balance of about \$8.8 billion as of the end of fiscal year 1986. Table 2.2 shows our calculation of the unrecovered government costs for fiscal years 1971 through 1986.

Chapter 2
 Many Problems Affect DOE's
 Enrichment Program

Table 2.2: Unrecovered Government Costs of the Uranium Enrichment Program

Dollars in millions

Fiscal Year	Operation & Other Costs	Plant Upgrades	Gas Centrifuge Facility	Total Approp.	Imputed Interest ^a	Total Government Costs	Revenues	Unrecovered Government Costs	Cumulative Unrecovered Govt. Costs
Original Investment						\$1,508.0 ^b		\$1508.0 ^b	\$1,508.0 ^b
1971	\$177.4	\$—0—	\$—0—	\$177.4	\$53.5	230.9	\$236.0	\$(5.1)	1,502.9
1972	196.4	25.0	—0—	221.4	33.6	255.0	165.2	89.8	1,592.7
1973	242.5	25.0	—0—	267.5	52.2	319.7	266.1	53.6	1,646.3
1974	110.0	121.7	—0—	231.7	79.2	310.9	460.2	(149.3)	1,497.0
1975	466.2	162.4	—0—	628.6	46.3	674.9	323.6	351.3	1,848.3
1976 ^c	496.9	345.5	12.6	855.0	72.4	927.4	612.0	315.4	2,163.7
1977	1,018.8	428.8	167.3	1,614.9	81.8	1,696.7	717.9	978.8	3,142.5
1978	1,097.4	207.7	150.0	1,455.1	424.7	1,879.8	1,045.8	834.0	3,976.5
1979	1,037.7	97.0	150.0	1,284.7	393.7	1,678.4	1,414.2	264.2	4,240.7
1980	973.3	64.6	322.7	1,360.6	523.7	1,884.3	1,304.1	580.2	4,820.9
1981	1,313.8	—0—	149.2	1,463.0	683.9	2,146.9	1,335.7	811.2	5,632.1
1982	1,218.0	—0—	588.0	1,806.0	482.7	2,288.7	2,062.8	225.9	5,858.0
1983	1,246.1	—0—	588.0	1,834.1	627.4	2,461.5	2,169.4	292.1	6,150.1
1984	1,652.3	—0—	580.5	2,232.8	599.4	2,832.2	1,727.0	1,105.2	7,255.3
1985	1,300.0	—0—	350.0	1,650.3	606.6	2,256.9	1,546.5	710.4	7,965.7
Transfers ^d	(213.3)	—0—	—0—	(213.3)	—0—	(213.3)	—0—	(213.3)	7,752.4
1986	1,221.9	—0—	327.1	1,549.0	750.0	2,299.0	1,240.4	1,058.6	8,811.0
Total	\$13,555.4	\$1,477.7	\$3,385.4	\$18,418.8	\$5,511.1	\$25,437.9	\$16,626.9	\$8,811.0	

^aCalculated using the current interest rate which is based on the current cost of borrowing as determined annually by the Department of the Treasury

^bOriginal investment in enrichment program on July 1, 1970

^cFifteen-month period from July 1, 1975, through September 30, 1976

^dBetween 1981 and 1985, DOE transferred \$213.3 million to other programs and activities.

Source: Prepared by GAO using data provided by DOE's Office of Uranium Enrichment and the enrichment program's fiscal year 1971 to 1986 financial statements

The total amount of costs to be recovered has generated controversy for several years. For example, nuclear utility representatives believe that the program has received revenues over the years covering all but a relatively small amount of production costs—about \$350 million. They do not recognize the need to recover the initial \$1.5 billion investment. They also argue that investments in the gas centrifuge enrichment plant were paid by appropriations approved by the Congress; therefore, they do not need to be repaid to the Treasury.

DOE generally agrees with our calculation. However, in January 1986 DOE proposed to change the criteria that set forth the terms and conditions under which DOE operates the enrichment program. In the criteria DOE proposed to write off about \$4.1 billion of these costs. Because of the program's changing business environment, DOE argued that these costs were associated with assets that were no longer productive—gas centrifuge enrichment plant development and undepreciated gaseous diffusion plant upgrades. As required by the Atomic Energy Act, DOE submitted the proposed criteria to the Congress on July 24, 1986, for a 45-day review period. During the 45 days, both the Senate and the House debated the merits of the criteria. As a result of these deliberations, the Congress, in the Continuing Appropriations for Fiscal Year 1987, prohibited the use of government funds to implement certain aspects of the criteria and reserved the right to determine later how much DOE should return to the Treasury. Nevertheless, DOE wrote off the \$4.1 billion and structured its pricing schedule to recover about \$3.4 billion over the next 10 years.³

Under the Atomic Energy Act, DOE may write off unproductive costs if these costs are recovered in its prices. Further, economic and generally accepted accounting principles allow the write-off of unproductive assets but suggest that current interest rates be applied to the remaining balance. Contrary to the law and these principles, DOE wrote off the costs without recovering them through prices and began using an historic interest rate in its 1986 financial statements to determine the amount of imputed interest.

Environmental and Decommissioning Costs for the Diffusion Plants Could Be in the Billions of Dollars

DOE currently enriches uranium in gaseous diffusion plants located in Portsmouth, Ohio, and Paducah, Kentucky. DOE placed the third plant in Oak Ridge, Tennessee, in standby condition in 1985. These plants, originally constructed to produce enriched uranium for the nuclear weapons program, were built in the 1940s and 1950s.

In 1985 after cancelling the gas centrifuge plant, which had been expected to replace the gaseous diffusion plants by 1990, DOE decided to use the gaseous diffusion plants past the year 2000. However, the plants present potential problems for DOE. First, DOE could be required to make expensive upgrades to comply with environmental legislation. Second, decontamination and decommissioning costs—which are not being

³DOE's analysis included long-range demand and production cost forecasts. It also assumed that DOE would keep its present customers and pay all TVA demand charges.

recovered by DOE through current prices—may exceed \$1 billion for each plant.

DOE is just beginning to study the potential cost of complying with existing environmental laws and to decontaminate and decommission the diffusion plants once they are no longer productive. Monitoring efforts are underway at all three plant sites to determine what must be done to conform with requirements of the Resource Conservation and Recovery Act, the Comprehensive Environmental Response, Compensation, and Liability Act (Superfund), and other environmental legislation. A June 1987 DOE study concluded that compliance with these acts will cause environmental costs at the three gaseous diffusion sites to rise rapidly. The study identified more than 90 areas or solid waste management units needing further review and developed preliminary estimates of the cost of a compliance program at each area. The estimates included costs for initial assessments, compliance activities, and long-term monitoring. The study showed that these costs could total between \$179 million and \$355 million between now and the year 2000 for the three plants.

In addition to environmental compliance, DOE is assessing the costs to decommission the diffusion plants. A March 1987 draft decommissioning strategy report indicates that DOE is considering a phased approach. First, DOE would place the plants in standby, the current status of the Oak Ridge plant. Then it would place the plants in "safe storage," a condition in which DOE would decontaminate the plants by removing hazardous and/or radioactive substances. When the decontamination process is complete, safe storage would be terminated, and DOE would begin the decommissioning phase. This could involve returning the site to a "green field" condition by removing the equipment and tearing down the buildings. The draft report advised against rushing into this phase, as the decommissioning process itself will cause worker exposure problems and generate large quantities of contaminated waste for which DOE would have to find a suitable disposal site.

DOE estimates it would take about 5 years and cost a total of about \$66.4 million to place the Oak Ridge plant in safe storage. It would then cost about \$7 million annually to maintain it in that condition, as compared with the \$20 million now required to maintain it in standby. The annual cost estimated to maintain the site in safe storage does not include potential major expenses, such as roof repairs. To complete the final decommissioning phase at Oak Ridge could cost about \$1.17 billion (1987 dollars) according to DOE. To date, DOE has not set aside funds to

cover decommissioning costs. A DOE official told us that when DOE decides to decommission the plant, it will include the costs in its prices.

Future DOE Demand Picture Is Cloudy

The future demand for DOE's enriched uranium is clouded by the uncertain future of nuclear power and competition from international suppliers. Many domestic utilities have delayed or cancelled their nuclear power construction programs and terminated their enrichment contracts with DOE. At the same time foreign competitors, who now supply about 50 percent of the total worldwide enrichment services, are aggressively seeking the enrichment business DOE once monopolized. In addition, one foreign supplier is assessing the feasibility of building an enrichment plant in the United States. Further, the uncertainty created by the uranium miners' litigation has cast a shadow on DOE's enriched uranium demand.

DOE Projected Demand: 1988 to 2000

DOE's Office of Uranium Enrichment develops long-term projections of commercial demand for DOE's enrichment services. These projections are based on data pertaining to operating nuclear plants and those under construction or seeking regulatory approvals. DOE gathers data from a variety of sources, such as press releases, publications, consultant reports, marketing officials, and the utilities.

For its most recent forecast, completed in December 1986, DOE divided the world into four regions: (1) the United States, (2) Far East, (3) Europe, and (4) other countries, and developed four cases: utility, high, mid, and low. The utility case represents the industry's future projection of operating plants; the high case represents an optimistic expectation of when plants will be in operation; the mid case represents the most likely projection when plants will come on line; and the low case assumes that nuclear power plants will take longer to complete than currently expected. In each case DOE assumed a price strategy that would recover all production costs plus \$3.4 billion in past unrecovered costs over the next 10 years.

DOE's 1986 mid case projections indicate a significant decrease from its 1981 projection in the total number of SWUs to be delivered. In 1981 DOE projected that demand for its enrichment services in 1990 and 1995 would be about 25 million and 30 million SWU, respectively. Table 2.3 shows DOE's current mid case SWU delivery projections for fiscal years 1988 through 2000.

**Table 2.3: DOE's 1986 Mid Case SWU
 Projection, Fiscal Years 1988-2000**

	Fiscal Years (million SWU)			
	1988	1990	1995	2000
U.S.	8.0	8.9	9.9	8.7
Far East	3.3	3.6	4.0	4.9
Europe	0.7	0.8	0.7	0.6
Other Countries	0.0	0.1	0.1	0.1
Total	12.0	13.4	14.7	14.3

Source: DOE.

Foreign Competition Is Growing

The marketplace for uranium enrichment is international in nature. Currently, DOE, Eurodif (France and other European countries), Urenco (the Netherlands, Germany, and the United Kingdom), and Techsnabexport (Soviet Union) are the major suppliers of enrichment services. In addition, Japan, South Africa, Brazil, and Argentina are developing new facilities to satisfy a portion of each country's requirements. This new production capability is likely to replace and reduce future deliveries of current enrichment suppliers, especially in the Japanese market.

Eurodif, a consortium with representatives from France, Spain, Belgium, and Italy, is the second largest enrichment supplier in the world. It has a capacity of about 10.8 million SWU per year and about a 32-percent share of the enrichment market. Eurodif uses the gaseous diffusion process with on-site nuclear power plants providing low-cost electricity. Eurodif's largest customer, in addition to its French and Belgium partners, is Japan.

Urenco consists of both private and government partners located in Germany, the United Kingdom, and the Netherlands. The consortium has three centrifuge facilities, one in each of these countries. Current enrichment capacity is between 1.8 to 2.1 million SWUs per year; however, Urenco can quickly add incremental capacity in response to demand increases. Urenco's share of the world market is about 7 percent, but it is exploring the possibility of building a centrifuge plant in the United States. Outside the consortium, Urenco's major customers are Brazil and Sweden.

Techsnabexport provides enrichment services by diffusion for the Soviet weapons program and the utilities of the communist bloc countries. Historically it has offered about 3 million SWUs per year to western customers. The Soviet Union traditionally undercuts DOE's enrichment

prices; its current capacity or expansion plans are not made known to the rest of the world.

Several other countries are developing enrichment technology but at present only Japan could become a serious competitor in the future. Japan is developing a centrifuge process and plans to produce annually 150,000 SWU by 1991 for its domestic market and 3 million SWU by the year 2004. In addition, Japan is working on a laser enrichment process. Although Japan does not currently plan to market its enrichment services to other countries, its plans could change if it develops a low-cost laser process.

Uranium Miners' Lawsuit

Section 161(v) of the Atomic Energy Act requires DOE to restrict the enrichment of foreign uranium to be used in domestic reactors or facilities under domestic control to the extent necessary to assure the maintenance of a viable U.S. uranium industry. In 1984 and 1985, DOE concluded that the industry was not viable but has not taken any action to revive the industry, such as requiring domestic utilities to purchase uranium ore from domestic sources. DOE has stated that such actions would not be sufficient to revive the industry and would severely hurt its market.

In December 1984, several uranium producers filed suit asking the U.S. District Court in Colorado to order DOE to, among other things, limit imports of foreign uranium to ensure the U.S. uranium industry's viability. On June 26, 1986, the court issued an order restricting DOE from enriching foreign-origin uranium for use in domestic reactors or facilities under domestic control to 25 percent from June 6 through December 31, 1986, and to a total restriction from January 1, 1987, until the domestic uranium industry's viability is ensured. DOE appealed the order to the U.S. Court of Appeals for the Tenth Circuit, and a stay was granted. In July 1987 the Court of Appeals affirmed the lower court's ruling and dissolved the stay. By November 1987, DOE expects to petition the U.S. Supreme Court to review the case.

According to DOE officials, restricting the enrichment of foreign uranium under section 161(v) of the Atomic Energy Act will not help the domestic uranium industry become viable. DOE contends that, if a court-ordered embargo is implemented, U.S. utilities that have DOE enrichment contracts will have two options:

- Continue to buy enrichment services from DOE and purchase uranium ore from domestic suppliers.
- Terminate DOE enrichment contracts and obtain enrichment services from foreign sources while retaining their original uranium ore sources.

DOE believes a large number of domestic utilities would take the second option and purchase both enrichment services and cheaper uranium ore from foreign sources. As a result, DOE believes it would lose enrichment customers, and the uranium mining industry would not be helped. In response to DOE, the uranium miners argue that foreign enrichment suppliers do not have excess capacity to meet the needs of DOE customers and would not necessarily add new capacity because they would be concerned that the Congress would impose further import restrictions.

DOE Revitalization Efforts Have Not Solved All Problems

DOE has taken steps to try to revitalize its competitive standing in the uranium enrichment market. Although these steps have cut costs or improved sales, many problems, such as the TVA demand charges and the growth in unrecovered government costs, remain. Therefore, DOE will still find it difficult to compete in the worldwide enriched uranium market.

In addition, some of DOE's cost-cutting steps may not be in accord with the program's statute and may adversely affect the program's competitive position in the future. For example, to cut current production costs, DOE meets current-day demand primarily by selling its enriched uranium inventory. In future years, after its inventory is depleted, DOE will be forced to produce at higher levels to meet demand, which will raise electricity and other costs. DOE expects this practice to increase costs by about \$80 million over the next 4 or 5 years.

As a next step toward resolving its problems and improving its competitive standing, DOE believes that the Congress should restructure the program as a federally chartered enrichment corporation. DOE believes that such action would allow it to become a competitive supplier of enriched uranium. However, DOE's proposal does not address several program problems, such as the need to upgrade its aging production plants. We believe that other legislative alternatives exist that would not require restructuring the program but would address some of its specific problems. These include establishing a revolving fund and freezing the amount of unrecovered costs to be paid to the Treasury.

Some DOE Efforts to Cut Costs Shortchange the Future

Beginning in 1984 DOE embarked on a strategy to maintain a competitive enrichment enterprise—one that would at least retain its existing market share. DOE issued new contracts—called utility service contracts—for its customers,¹ halted construction of the gas centrifuge enrichment plant after spending about \$3.5 billion, and shut down the Oak Ridge enrichment plant, thereby saving an estimated \$300 million through fiscal year 1991. In addition, DOE revised its pricing policy to recover only about \$3.4 billion of unrecovered costs over the next 10 years. However, the Congress, in the Continuing Appropriations for Fiscal Year 1987, reserved the right to later determine how much DOE should return to the Treasury. DOE also initiated a number of technical steps to improve operating efficiencies at the two remaining plants. (DOE's steps to revitalize the program are discussed in app. I.)

¹The utility services contracts have been challenged in court as part of the uranium miners' suit.

In fiscal year 1987 DOE took two additional steps in an effort to cut costs even further. It decided to cut current production costs by selling existing enriched uranium inventories and deferred funding for the AVLIS research and development program.

DOE Is Producing at Less Than Optimal Levels

In January 1987 DOE released an operating plan for the enrichment program dedicated to the goal of meeting projected demand at minimum cost. A key element of the plan was the sale of preproduced enriched uranium from inventory. By meeting current demand from the inventory, DOE believes it will improve its cash flow since it will not have to pay for the large amounts of electrical power needed to meet demand from current production. However, current production costs are low compared with those expected in the near future when DOE will have to increase production to meet demand.

DOE states that it needs at least a 120-day supply of enriched uranium (about 5 million SWU) in inventory to maintain delivery lead-time flexibility. However, at the end of fiscal year 1986 the inventory consisted of approximately 18 million SWU. DOE plans to produce only 4.2 million SWU in fiscal year 1988 even though total demand is expected to be 12.5 million. By the end of fiscal year 1988, DOE's excess inventory will be exhausted forcing much higher production levels beginning in fiscal year 1989. Table 3.1 shows DOE's planned production strategy.

Table 3.1: DOE Enrichment Production Plan

Fiscal Year (million SWU)	1988	1989	1990
Beginning Inventory	12.9	3.9	4.4
Sales ^a	12.5	15.8	16.6
Production	4.2	14.8	16.6
Ending Inventory ^b	3.9	4.4	4.4

^aIncludes military sales

^bEnding inventory does not equal beginning inventory and production less sales because of adjustments made to reflect different levels of enriched uranium.

Source: DOE.

According to DOE, its production strategy is not cost efficient. The cost of producing an additional SWU increases significantly at higher production levels, primarily because electricity rates rise substantially as production levels increase. For example, according to DOE, the power to produce an additional SWU costs about \$28 at a production level of 4.8 million versus \$58 at a 14.0 million production level. DOE estimates it will lose

about \$80 million over the next 4 to 5 years by not producing at a more optimum level in fiscal year 1988 and lowering production in later years. However, DOE officials say they are precluded from raising fiscal year 1988 production by the program's current high costs and the need to meet annual budget targets.

DOE Proposes to Cut AVLIS Funding

DOE initiated research and development efforts at the Lawrence Livermore National Laboratory in 1973 on the AVLIS process. AVLIS is based on the fact that the two uranium isotopes (U-235 and U-238) absorb different colors of light. Lasers are tuned to emit a combination of colors that are absorbed only by a U-235 atom, which subsequently emits an electron. This leaves the U-235 atom with a net positive charge, allowing the atom, now an ion, to be selectively separated using electromagnetic fields. The AVLIS process includes two major component systems: a laser system and an electromagnetic separator system. According to DOE, AVLIS promises lower operating costs (\$30 to \$45 per SWU) relative to the energy intensive gaseous diffusion plants.

DOE has a three-phase AVLIS development program: technology development, engineering demonstration, and production demonstration. Early in fiscal year 1987, DOE had essentially completed technology development and demonstrated a full-scale laser. DOE is building a full-scale separator facility and expects it to be operating in calendar year 1989. DOE believes that its progress on AVLIS to date represents a 3- to 5-year lead over foreign competitors who are developing the technology such as Japan and France.

Following an intensive evaluation effort, the Secretary of Energy announced in June 1985 that DOE had decided to end its investment in the gas centrifuge program and channel all research and development efforts into AVLIS. DOE's fiscal year 1987 appropriation for AVLIS anticipated a funding level of \$80 million, and thus far, DOE has invested about \$460 million in the process. DOE estimates it will cost at least an additional \$400 million to fund the project through the engineering demonstration phase and an additional \$1 billion for a full-scale plant (10 million SWU per year). DOE believes it could accomplish the engineering demonstration by the mid-1990s given funding of about \$100 million per year.

According to DOE officials, in an attempt to cut program costs, the Office of Management and Budget directed DOE not to request fiscal year 1988 funding for AVLIS. For its fiscal year 1988 budget, DOE stated that the

party who will be responsible for the business in the long-term—presumably a private firm—should assume the risks and costs associated with AVLIS. However, DOE fully expects the Congress to continue funding AVLIS and has not instructed the laboratory staff to begin shutdown procedures. As of September 1987, the full House and Senate Committee on Appropriations approved funding for the enrichment program that anticipates a funding level of \$100 million for AVLIS in fiscal year 1988.

If the Congress does not fund AVLIS, the potential exists for one of DOE's competitors to develop the process and produce and sell SWUS at well under DOE's costs. In addition, if AVLIS produces low-priced SWUS as predicted, the initial supplier would have a significant competitive advantage in the worldwide enriched uranium market. DOE officials believe that AVLIS should be able to recover all development costs within 10 to 15 years after it comes on line.

DOE Analysis of Program Options

As the financial problems of the DOE uranium enrichment program developed in the 1980s, DOE program officials became convinced that the existing program structure was partly responsible for their inability to adequately respond to foreign competition and customer concerns. They also believed that the program has historically suffered from an inflexible budget process and management system. Further, they believe that the program lacks a unified decisionmaking procedure, a clear statement of objectives, and a consistency of purpose. DOE officials attribute this to the fact that the Office of Management and Budget, the White House, and the Congress have, at times, conflicting voices in program decisions. These problems, DOE officials believe, handicap its competitiveness and threaten its reliability to supply enrichment services.

DOE believes that it will become the enriched uranium "supplier of last resort" if no significant changes are made to cut existing costs or to change its management structure. Under existing conditions DOE believes its prices may have to remain the same or rise to recover costs. At the same time, DOE predicts that in order to maintain its existing market share its price will have to drop in the next several years. DOE officials say that if they have to raise prices, sales will drop dramatically over the next decade.

In one "disaster case" analysis, where DOE assumed that competitors would expand capacity to supply customers who make purchase decisions on the basis of price alone, DOE estimated that commercial sales would drop 50 percent by 1991 and to practically zero by 2006. Even so,

DOE estimated it would recover about \$876 million (in 1987 dollars) from 1987 through 1996. This positive cash flow resulted because the analysis assumed that AVLIS research would be eliminated and other program improvements would not be completed.

DOE officials, however, have always rejected any strategy that does not include a commitment to maintaining a competitive program to meet long-range national goals. Therefore, in 1986 they formed a working group to study options for restructuring the uranium enrichment program with the stated goal of retaining a healthy enrichment business. The study also analyzed benefits to the U.S. Treasury, customers, and potential investors, and identified and analyzed obstacles to divesting the government's assets quickly.

The working group conducted its evaluation within the following three general organizational frameworks.

- retention of the current DOE organization,
- sale or lease of the government's assets to a private sector firm, and
- formation of a government corporation.

DOE analyzed 13 scenarios that took into account various alternatives for the existing gaseous diffusion plants, AVLIS research and development, and AVLIS operations. DOE also considered different ownership structures for AVLIS and the gaseous diffusion plants: DOE-owned, government corporation, a mixed corporation,² or private ownership. The analysis, using a computer program developed by the Lawrence Livermore National Laboratory, showed the production and finances of the enrichment enterprise under each scenario. It included DOE-generated demand projections, inflation rates, tax rates, AVLIS development costs and startup dates. DOE derived results for both the government (how much and how fast funds are returned to the Treasury) and the private sector (how much investment is required and what the rate of return is).

Table 3.2 shows the cash flow for the 13 scenarios analyzed by the model, the rates of return for a private owner, if appropriate, and ownership and deployment of AVLIS.

²The study defined a mixed corporation as one in transition from government corporation to a private firm, where part of the assets were owned by the private sector.

**Chapter 3
DOE Revitalization Efforts Have Not Solved
All Problems**

Table 3.2: Treasury Cash Flows for DOE-Identified Enrichment Scenarios

Dollars in billions

Scenario	GDP ^a Status	AVLIS RD&D	AVLIS Operator	Treasury cash flows ^b			Private IRR ^c (percent)
				Through 1992	Through 2002	Through 2012	
1. Public GDP, AVLIS not Deployed	DOE	•	•	\$1.12	\$3.34	\$4.29	na
2. Public GDP, Private AVLIS	DOE	Priv.	Priv.	1.22	3.89	6.51	13.1
3. Public GDP and AVLIS	DOE	DOE	DOE ^d	0.69	2.40	7.42	na
4. Government Corporation	Govt.	Govt.	Govt.	0.37	3.11	8.14	na
5. Mixed Corp., No AVLIS	Priv.	•	•	1.94	3.52	3.85	5.1
6. Mixed Corp., with AVLIS	Priv.	Priv.	Priv.	1.69	3.37	5.69	9.9
7. Mixed Corp., Public RD&D	Priv.	DOE	Priv.	1.31	3.05	5.37	11.1
8. GDP Only, Private Purchase	Priv.	•	•	2.87	3.53	3.85	5.3
9. GDP and AVLIS, Private Purchase	Priv.	Priv.	Priv.	2.62	3.37	5.69	9.1
10. GDP Only, Private Lease	Lease	•	•	1.04	2.57	3.00	12.2
11. GDP and AVLIS, Private Lease	Lease	Priv.	Priv.	1.04	2.71	5.05	13.0
12. Private GDP and AVLIS, DOE RD&D	Priv.	DOE	Priv.	2.23	3.05	5.37	9.8
13. Leased GDP, Private AVLIS, DOE RD&D	Lease	DOE	Priv.	0.49	2.30	4.64	16.2

^aGaseous diffusion plants.

^bNet present value in 1988 of Treasury cash flows at 6-percent discount rate.

^cInternal rate of return

^dOperations begin in 1998. For all other scenarios, operations begin in 1996

Source: DOE December 1986 draft report, entitled Options for Restructuring the Uranium Enrichment Enterprise: Asset Divestiture and Government Corporations

Table 3.2 shows that the scenarios with the highest near-term return to the Treasury (5, 8, 9, and 12) are those without a government-funded AVLIS plant. In the long run, however, those with the highest return (2, 3, 4, 6, and 9) include AVLIS, especially if the government owns it or controls its sales. The highest returns to the Treasury are generated by a government corporation that rapidly develops AVLIS. In these cases the returns generated by DOE or the government corporation are heavily influenced by the projected "profits" resulting from AVLIS production, which the model assumes will start in 1996 or 1998.

The rates of return generated on private invested capital in the analysis show that a private investor would be reluctant to purchase the uranium enrichment business in 1987, at least at the \$2.8 billion the analysis assumed as the value of the enterprise. As table 3.2 shows, a lease arrangement for government assets would be most attractive to the investor because it would generate the highest internal rate of return.

However, the lease options would generate low returns to the Treasury. A direct sale to the private sector would probably return the most to the Treasury in the near-term, but DOE concluded that the rate of return to investors would probably be too low to interest the private sector—unless the price was substantially below the assumed value of the enterprise. In April 1986 DOE solicited expressions of interest in the uranium enrichment enterprise; the results supported DOE's analyses.

A total of 16 private firms and individuals submitted replies, including 6 major U.S. corporations with nuclear fuel cycle experience, and 1 foreign enrichment supplier. Of these, 12 expressed general interest in private sector enrichment, but no immediate interest in assuming control of the gaseous diffusion plants or AVLIS research. Almost all respondents believed that important institutional issues, such as licensing requirements and insurance preconditions, had to be resolved by the Congress before the private sector could participate in uranium enrichment. Only the American Enrichment Company expressed interest in immediate negotiations with DOE for the private production of enriched uranium. (See app. I for a discussion of its proposal.)

Following the solicitation, DOE concluded that the formation of a federally chartered enrichment corporation was most consistent with DOE's overall objective of maintaining a healthy U.S. enrichment enterprise. DOE officials also believe that a competitive enrichment program is needed to support the nation's energy and defense security objectives, nonproliferation goals, and balance of payments. DOE officials believe that a corporation would (1) yield greater opportunities for a more equitable distribution of benefits among customers, taxpayers, and private investors, (2) provide a more focused management structure, (3) allow greater financial flexibility, and (4) permit more consistent relations with its customers.

DOE's Proposal to Restructure the Uranium Enrichment Enterprise Is Not Complete

In February and March 1987 letters to the Chairmen of the cognizant House and Senate Appropriations Subcommittees, DOE reported that in order to successfully compete, the uranium enrichment enterprise must be restructured to permit more businesslike operations. It also stated that the Congress needs to establish a consensus on the program's objectives; otherwise it would continue to lose its major asset—enrichment contracts with its customers. DOE rejected the option of maintaining the status quo, since this would lead to further deterioration of the enterprise. It also rejected the sale or lease option because of the lack of private sector interest, even though it recognized that benefits exist from privatization.

DOE stated in its March 31, 1987, letter that an independent, federally chartered enrichment corporation should take over the relevant assets of the DOE enrichment program as soon as possible and carry out its activities in a businesslike, competitive, and profitable manner. The letter proposed that the government receive stock representing the value of plant and equipment and other assets transferred to the corporation. This stock could pay a fixed dividend and could be sold by the government to the public. Thus, the ultimate value of the uranium enrichment facilities to taxpayers would be determined by total dividends and taxes paid by the corporation, and the actual sale price of the stock when sold by the government. DOE did not project what this value or the other returns to the government might be.

DOE also did not specify in its proposal how a number of the existing program problems would be addressed, stating only that these problems need to be resolved before formation of a corporation, and that it would work with the Congress to structure enabling legislation. These problems include the following:

- The need to recover past costs: The proposal states that the return to the Treasury would depend on the sales price of the government's shares in the corporation when the shares are sold. It does not specify the amount or timing of cost recovery efforts.
- The ability to continue the development of AVLIS: The proposal states that future technology development would depend on the corporation's need to be competitive in the future.
- The multibillion-dollar TVA demand charges: The proposal states that it is unclear whether the corporation can assume responsibility for the demand charges and expect to be economically viable.

- The need to decontaminate and decommission the gaseous diffusion production facilities: The proposal does not address responsibility for, or the costs of, decontaminating and decommissioning the existing plants.

In addition, the proposal does not include provisions for congressional, audit, and budgetary oversight, such as those included in the Government Corporation Control Act. Finally, the proposal raises several other issues but does not discuss how they would be resolved under a corporate structure. These include the following:

- Enriched uranium for defense needs: The proposal states that DOE would retain the capacity to enrich uranium for defense purposes but does not specify how DOE would segregate, administer, or operate the defense portion of the Portsmouth plant, which also enriches uranium for commercial customers.
- NRC's licensing and regulatory requirements: The proposal states that the corporation may have to resolve these issues but does not discuss the timing or specific actions needed.

Legislative Proposals

Following DOE's proposal two bills were introduced in the Congress to establish a government enrichment corporation (S.1084 and S.1100). The bills as amended include similar provisions that would

- establish a corporate structure with management reporting to the Secretary of Energy,
- provide an exemption from NRC licensing until sufficient time has elapsed to allow regulatory compliance,
- establish the amount of past costs to be recovered at \$350 million (S.1100) or \$364 million (S.1084),
- provide for public or private financing, and
- exempt the new corporation from federal and state income taxes.

However, some significant differences exist between the two bills. For example, S.1100 would require domestic utilities to use enriched uranium containing an escalating percentage of domestic ore. In addition, \$300 million of the recovered costs would be paid into a mill tailings fund to be used to clean up uranium mining environmental problems. Prices would be determined solely by the new corporation with no provision for future dividend payments to the Treasury. S.1100 would also

- allow a credit limit of \$3.5 billion for loans from the Treasury to be used if private sources are not available,

- provide for Comptroller General audits, and
- place the program off-budget.

On the other hand, S.1084 would limit borrowing from the U.S. Treasury's Federal Financing Bank to \$1 billion and subject the corporation to the Government Corporation Control Act, which requires that a government corporation's finances be part of the federal budget. It also specifies that pricing should be set to cover all costs over the long-term including the established debt. Excess miscellaneous revenues and dividends earned on government stock are to be paid to the Treasury.

As of October 1987, the Senate Committee on Energy and Natural Resources was working on a bill that would combine aspects of both S.1100 and 1084. One new provision being considered by the committee staff would cap the amount DOE would pay to TVA to resolve the ongoing contract dispute.

Other Options

Although a corporate structure could address some of the problems of the existing program, several other options or specific steps exist that the Congress could take to address one or more of the problems. These steps would not require restructuring the program, although some could be done simultaneously with such a reorganization. These steps include (1) mandating domestic utilities to purchase their enrichment needs from DOE, (2) "freezing" or reducing the amount of costs to be recovered to a manageable level, and (3) establishing a revolving fund within the existing organizational structure.

Legislated Monopoly

The National Taxpayers Union has suggested that domestic nuclear utilities should be required to purchase enriched uranium from DOE. The union contends that DOE has the authority to institute such a requirement under existing legislation. It also argues that DOE could then charge prices necessary to recover all costs.

The National Taxpayers Union also says that raising the price of enriched uranium would not significantly raise ratepayers' costs. For example, they say that if enriched uranium was priced at \$160 per SWU, fuel prices for ratepayers would increase less than one mil (\$.001) per kilowatt hour of electricity generated. Basically this occurs because enrichment costs are only about 40 percent of the average cost of nuclear fuel. Further, the cost of nuclear fuel is a small part (less than 10 percent) of the total cost of nuclear electricity.

The administration and DOE oppose this strategy because it (1) would violate existing contracts with the utilities, (2) is anticompetitive, and (3) would provide a disincentive to nuclear power. DOE also contends that foreign customers, which in 1985 accounted for \$525 million, or 40 percent, of DOE's sales, would quickly turn to other sources, unless DOE was allowed to charge them lower prices than its domestic consumers. Currently, DOE is prohibited by the Atomic Energy Act from charging customers different prices.

Freezing or Lowering the Amount of Costs to Be Recovered

Under the program's enabling legislation, DOE must recover government costs associated with producing enrichment services over a reasonable period of time. As of the end of fiscal year 1985, we calculated the amount of unrecovered costs including imputed interest to be about \$7.8 billion. In fiscal year 1986 enrichment program costs exceeded revenues by about \$300 million and imputed interest on the total government investment was about \$750 million, raising the total amount of unrecovered costs to about \$8.8 billion. Obviously, total annual imputed interest charges will soon reach \$1 billion unless DOE can collect revenues over and above current costs so that total unrecovered costs can be reduced.

If DOE were to recover the \$8.8 billion within a reasonable time, it would have to charge its customers a noncompetitive price—over \$170 per SWU—compared with DOE's 1986 SWU price of about \$119. In order to keep its prices competitive, DOE formally proposed in 1986 in its criteria to recover only about \$3.4 billion of these costs. DOE has structured its present pricing policy to accomplish this over the next 10 years. However, the Congress, in the Continuing Appropriations for Fiscal Year 1987, reserved the right to determine the amount the program owes the Treasury.

The amount of costs to be recovered and the need to meet annual budget projections have in part led DOE to propose a cut-off in funding for AVLIS and institute a less than optimal production strategy. Several options exist to resolve the unrecovered cost issue, although each would require congressional action. For example, the Congress could

- excuse the existing amount of unrecovered costs and enact legislation establishing the amount at any level it wishes;
- allow the "write-off" of costs associated with nonproductive assets, such as the gas centrifuge program, as DOE proposed last year; or

- “freeze” imputed interest costs and/or the total amount of costs to be recovered at a given level to prevent the accumulation of imputed interest until the program is back on firm financial ground, perhaps at the expiration of the TVA contracts or when AVLIS operates.

Establishing a Revolving Fund

DOE states that a key problem hindering its ability to respond to changing business conditions is a lack of flexibility to function in a business-like manner. DOE has proposed to restructure the program as a corporation in part to improve this situation. A revolving fund within the existing program structure could also provide DOE with more flexibility to deal with an increasingly competitive marketplace.

Revolving funds are authorized by specific legislation for recording the transactions of a continuing cycle of operations. Receipts derived from such operations are available in their entirety for use by the fund, subject to such limitations as may be imposed by law. One type of revolving fund, called a public enterprise revolving fund, is an expenditure account authorized by the Congress to be credited with collections, primarily from the public. The funds are then used to finance a continuing cycle of business operations. This can sometimes provide more steady and timely funding than when the receipts must go to the general fund of the Treasury and, as a consequence, the program must depend upon an annual appropriation rather than its generated receipts. Such steady and timely funding may be important for certain businesslike operations.

We believe that such public enterprise revolving funds are suitable when a program can be substantially self-sufficient, and when the Congress chooses to reduce a program's dependence upon annual appropriations and increase funding stability and timeliness. The uranium enrichment program involves an ongoing business relationship that generates revenues from the private sector, and DOE believes that the program could be substantially self-sustaining if some of its problems are solved. The Congress should determine whether the program should be made less dependent upon annual appropriations.

Conclusions and Recommendations

The DOE uranium enrichment program continues to be in financial trouble, beset by large TVA demand payments, growing unrecovered costs, and increasing foreign competition. Its financial standing is further threatened by the uranium miners' lawsuit and future environmental costs. If nothing is done, the program is likely to be caught in a downward spiral resulting in (1) further loss of business, (2) little or no cost recovery, and (3) loss of its leadership position in the race to develop AVLIS. Although the program no longer has a monopoly over the enrichment market, DOE and others argue that a viable domestic program is needed to support the nation's energy and defense security goals, non-proliferation objectives, and to avoid further deterioration in the balance of payments.

Because of the importance of the program's national objectives, we have reported and testified on numerous occasions that the Congress should reevaluate the program in view of today's business environment.¹ We believe that the Congress' consideration should be directed at (1) the specific problems now threatening the program's future, and (2) the organizational structure needed to satisfy the program's goals. To revitalize the program DOE submitted a proposal to the Congress to restructure the program as a federally chartered corporation. While DOE's proposal is designed to give the program needed managerial flexibility, it does not address the specific problems that must be resolved if the program's financial viability is to be improved. In our view, some change to improve management flexibility is needed, but such a change will have little chance for success if the program's more fundamental problems are not resolved.

Problems Facing the Enrichment Program Need to Be Addressed

A range of program-related problems affect the future viability of the enriched uranium program. These problems must be resolved if the program is to have a chance to balance its cost recovery objectives with national goals established for the program. The problems include the

- requirements that restrict optimal enriched uranium production,
- amount of previously incurred government costs to be recovered,
- future of AVLIS, and
- decontamination and decommissioning of the plants.

¹Our April 8, 1987, testimony before the Subcommittee on Energy and Power, House Committee on Energy and Commerce, and our February 19, 1986, letter to the chairman of that same subcommittee on DOE's proposed revisions to the uranium enrichment services criteria contained these views.

We believe that the program should not be required to offset annual appropriations from current year revenues and make predetermined payments to the Treasury at the expense of long-range optimal production decisions. To meet these objectives and lower costs DOE is now producing at less than optimal levels even though it estimates this practice will cost more than \$80 million over the next 4 to 5 years.

Management flexibility could be improved within the current DOE structure or through the formation of a corporation. To improve management flexibility within the current DOE structure a revolving fund could be established for the uranium enrichment program. The fund would provide flexibility to meet long-range program requirements. We believe, however, that regardless of how the program is structured or financed, it should be subject to periodic appropriations process review and action.

We also believe that the amount of past costs the enrichment program should recover needs to be defined. Although present legislation requires the recovery of all government costs, we recognize that the existing program cannot expect to generate revenues sufficient to pay past costs totaling \$8.8 billion including imputed interest that is approaching \$1 billion annually. According to DOE, no price for its enrichment services would generate sales over the next 10 years sufficient to recover this amount, unless domestic utilities were required to purchase from DOE. Under current conditions if DOE attempted to raise its price to fully recover all past costs, the enterprise would lose even more customers.

To address this issue, the Congress is considering proposals ranging from full cost recovery to the recovery of as little as \$350 million as proposed in S. 1100. Although we believe that full cost recovery is not feasible, recovery of only \$350 million ignores (1) the large amount invested in the still productive assets of the program and (2) the potential cost recovery capability that DOE believes still exists in the program. We believe a practical solution would be to allow DOE to write off the unproductive program assets. This action, although requiring a change in the existing legislation, follows generally accepted accounting principles. DOE wrote off unproductive assets in 1984 and 1985 (without legal authority) setting the unrecovered amount at about \$3.4 billion. The final amount to be recovered would depend on when the Congress authorizes such a write-off.

We also suggest that the Congress take other related steps to balance the cost recovery objective with the need to maintain an ongoing program. Imputed interest costs could be frozen until the program is on firm financial footing, and DOE could be allowed the flexibility to set prices to meet market objectives. This may entail stretching out the current 10-year repayment schedule if sales are low, or accelerating cost recovery in years when sales are high. However, the Congress should recognize that these actions may not be effective if market conditions change, forcing DOE to choose between cost recovery and the other program objectives.

The Congress also needs to consider the future of AVLIS. In its fiscal year 1988 budget submission, DOE stated that a private firm should assume the costs and risks associated with continued AVLIS development; but until DOE develops the technology further, it is unlikely a private company will invest in AVLIS. However, according to DOE, AVLIS represents the program's best chance for long-term competition. If the Congress provides adequate funding, DOE expects AVLIS to come on line 3 to 5 years before comparable technology in other countries, thereby providing a competitive advantage that would allow DOE to recover development costs. As the program is further demonstrated, DOE may find the private sector willing to invest in AVLIS.

We also believe that DOE needs to act on its responsibility to decontaminate and decommission the enrichment plants. The Congress could encourage this by requiring DOE to include these costs in its pricing strategy now. The sooner this is done, the longer DOE would have to recover them, thereby reducing the impact on enrichment service prices. We have long supported the concept that decommissioning costs should be paid by the current beneficiaries of the service received.²

Two other problems affecting the future of the enrichment program—TVA demand payments and the need to restrict enrichment of foreign uranium ore—are currently being addressed by the courts. The Congress should realize that proposed legislative actions could affect the potential impact of court decisions in both cases. For example, a proposed Senate bill would cap the amount DOE would pay to TVA for unused power. However, since this is a contractual dispute, legislative action may not resolve the case. In contrast, the uranium miners suit stems, in part, from a requirement in the Atomic Energy Act that places some

²Cleaning Up The Remains of Nuclear Facilities—A Multi-Billion Dollar Problem (EMD-77-46, June 18, 1977).

responsibility on DOE for the viability of the domestic uranium mining industry. Therefore, it appears that legislative action to remove this responsibility, or to dictate the amount of foreign ore DOE can enrich for use in a domestic facility, would effectively resolve this dispute. Further, it appears that the executive agreement on trade between the United States and Canada to be reviewed by the Congress later this year may effectively remove any restriction on Canadian uranium ore imports beginning January 1989. Canadian ore makes up about 90 percent of the ore DOE's domestic customers import for enrichment.

DOE's Restructuring Proposal

DOE has proposed creation of a federally chartered corporation to (1) allow the enrichment enterprise to operate in a competitive, business-like manner with clear objectives, (2) free it from annual budget restrictions and other limitations, and (3) permit flexible pricing and contracts. Although we have generally opposed new government corporations, we recognize that under certain conditions a new corporation is justified. These conditions include (1) performance of a business function requiring many transactions with the private sector, (2) the potential ability to be self-sustaining, and (3) the need for greater financial flexibility than the appropriation process permits. We have also supported the formation of new corporations such as the Postal Service because certain existing legislative, budgetary, and financial policies imposed on management were inconsistent with modern business practices. The enrichment program faces many of these same problems and meets many of the criteria generally believed to be conducive to corporate management.

However, if a uranium enrichment corporation is formed, we believe it should be a government corporation subject to the Government Corporation Control Act instead of a federally chartered corporation as DOE proposed. The Government Corporation Control Act sets forth, in part, audit and budget oversight provisions that may not apply to a federally chartered corporation. (Our views on the specific requirements for a government corporation are given in more detail in app. II.)

Recommendations to the Congress

In order to place the enrichment program on firm financial footing, the Congress should enact legislation to

1. Define a reasonable amount of costs the program needs to recover. In defining the amount of costs to be recovered the Congress should allow the write-off of unproductive assets and consider freezing total interest charges.

2. Provide the enrichment program with sufficient budget and management flexibility to ensure that optimum production schedules are followed and long-term customer commitments are not compromised.

3. Allow DOE sufficient flexibility in setting its pricing strategy to allow it to meet market competition.

4. Require that DOE include future decontamination and decommissioning costs in its base of costs to be recovered.

In taking these actions, the Congress should also consider whether the enrichment program should be a corporation or continue as an entity within DOE. If the Congress decides that a corporate structure would best meet the program's goals, it should ensure that the corporation's charter addresses the specific problems creating an uncertain financial future for the program. The Congress should also require the new corporation to meet the provisions of the Government Corporation Control Act. In particular, the Congress should ensure that the corporation (1) is subject to sufficient congressional oversight including comprehensive audits by the Comptroller General, (2) submits financial plans that are a part of the U.S. budget, and (3) is held accountable to the President, through the Secretary of Energy.

Matters for Consideration of the Congress

As the Congress considers the structure of the enrichment program, it should consider the future of AVLIS. To assist in this evaluation, the Congress could require DOE to prepare a biannual report describing the costs, milestones, and risks associated with proposed AVLIS development.

The Congress should also be cognizant of the impact of ongoing litigation on the program. The amount of TVA demand payments and DOE's ability to enrich foreign uranium ore are now undergoing judicial review. The Congress should consider the negative impact of a court decision restricting DOE's enrichment of foreign uranium and determine whether it should amend the Atomic Energy Act to (1) remove DOE's responsibility to restrict foreign uranium enrichment in order to ensure the maintenance of a viable domestic uranium mining industry or (2) specify the amount of foreign uranium ore that DOE can enrich.

DOE Actions to Revitalize the Program

This appendix discusses the steps DOE has taken to revitalize the enrichment program. These steps include (1) implementing the utility services contract, (2) terminating the gas centrifuge enrichment plant, (3) making plant improvements, and (4) contracting for low-cost power.

Utility Services Contracts

In January 1984 DOE offered its 80 nuclear utility customers new utility services contracts, which included better prices and more flexible terms than earlier contracts.¹ The contract term is 30 years, although a customer can terminate without penalty with 10 years advance notice. The contracts established a 10-year ceiling price of \$135 per SWU, with annual adjustments for inflation. Customers are allowed to purchase up to 30 percent of their annual SWU requirements from non-DOE sources. According to DOE about 90 percent of DOE's customers converted to these contracts, establishing a stable planning base for DOE and allowing customers to reduce their existing inventories.

Once DOE established a customer base through the new contracts, DOE began a series of marketing initiatives to attract additional sales. In April 1985 DOE offered an incentive price of \$90 per SWU to attract uncommitted sales in the 1987-90 time frame. Eighty-seven percent of DOE's customers took advantage of this offer, increasing DOE's SWU sales by about 5.6 million with related revenues of about \$500 million through 1990.

In 1986 DOE tendered another incentive price offer. Customers who agreed to purchase 100 percent of their enrichment requirements from DOE during the period of 1991 to 1995 were offered a price of \$85 per SWU for the remaining 30 percent of their enrichment requirements. About 75 percent of DOE's customers accepted this proposal, which gave DOE additional sales of about 13.7 million SWU, with associated revenues of about \$1.2 billion through 1995.

Gas Centrifuge Enrichment Plant Cancelled

In the mid-1970s DOE began to develop gas centrifuge technology to meet projected demand for enrichment services. This technology promised lower operating costs as a result of lower electric power requirements. The economies did not materialize because of high development costs, and in June 1985, after spending about \$3.5 billion, DOE cancelled the

¹In their December 1984 lawsuit, the uranium producers petitioned the U.S. District Court in Colorado to declare these contracts invalid. As of September 1987, final action on this issue had not been taken.

centrifuge project and turned to the AVLIS technology, which shows potential for even lower operating costs.

After terminating the gas centrifuge program, DOE destroyed completed machines and components stored at the centrifuge manufacturers' facilities because of the high cost to store them on location or to ship them to the gas centrifuge enrichment plant at Portsmouth, Ohio. DOE did retain those machines and components at Portsmouth pending investigation into possible alternative uses for the machines or the entire facilities. DOE also retained some tooling used to produce the components.

Except for the American Enrichment Company, industry has shown little interest in operating the gas centrifuge facilities. In February 1986, the American Enrichment Company, Inc., a private company created specifically to acquire and operate the gas centrifuge enrichment plant, submitted a formal proposal to DOE. American Enrichment proposed that it be allowed to acquire—at no charge—the rights to the U.S. gas centrifuge uranium enrichment technology and related abandoned government facilities and equipment located at Portsmouth, Ohio. The company proposed to refurbish those portions of the plant necessary to begin initial operations utilizing existing equipment. It also proposed to acquire additional gas centrifuge machines of proven design. Company officials stated that installation of these newly manufactured machines, coupled with the existing equipment, will permit the annual production of about 1 million SWU by the mid-1990s.

American Enrichment officials argue that its proposal would allow existing nonproductive assets to generate income in the form of royalties and taxes to the government. They also believe DOE will not be competitive in the future, so they will be competing against foreign producers rather than DOE. They also argue that DOE could be in a "win-win" situation should DOE sales be 13 million SWU per year or more. The company calculates that above that level, rising power costs will cause DOE's marginal production cost to be more than its projected price.

DOE program officials have several problems with the American Enrichment proposal. First, they believe the company's production cost estimates are very optimistic. DOE does not believe the company has the financial and management resources necessary to operate the gas centrifuge plant. Second, DOE believes that if the company fails, DOE would be left with the responsibility of meeting its liabilities. Third, legal questions remain concerning the company's operation of the facility without a license issued by NRC. DOE also says its power costs would not increase

as fast as American Enrichment predicts, therefore, the company would be competing with DOE for SWU sales, using facilities obtained without cost. DOE formally rejected the proposal in June 1987 and is continuing to search for alternative uses for the gas centrifuge facilities.

Plant Improvements to Take Advantage of Nonfirm Power

According to DOE, using a substantial quantity of low-cost, nonfirm² power is a key to remaining competitive in the enrichment marketplace. However, improvements are needed at both the Paducah and Portsmouth plants to take advantage of lower cost nonfirm power. Most of these improvements are planned for the Paducah plant because DOE plans to operate the Portsmouth plant at a higher capacity, thereby requiring more firm power. DOE hopes to use nonfirm power for about 50 percent of Paducah's energy requirements. Total costs of the plant improvements to use nonfirm power are expected to be about \$165 million at Paducah and another \$3.4 million at Portsmouth. Most of the work will be completed by fiscal year 1993.

The required modifications fall into two categories: those necessary to allow the use of maximum plant capacity given significant power loss, and those necessary to take maximum advantage of nonfirm power. Projects are underway at Paducah and Portsmouth to relieve capacity limitations; these modifications are expected to cost \$6.1 million and \$2.3 million, respectively, and should be completed in 1990. In addition, portions of the cooling system at both plants must be rebuilt to allow maximum capacity operation. The work at Paducah should be completed in 1990 at a cost of about \$17.4 million. In addition, plans for cooling tower modifications at Portsmouth, estimated to cost about \$1.1 million, are undergoing DOE review but have no completion date.

To take advantage of low-cost nonfirm power, equipment known as freezer-sublimers are being used at both diffusion plants. Process gas is routed to these units and frozen when power is to be withdrawn from the diffusion process. When power is again available, the gas is thawed and returned for processing. Initial units were installed at both plants in the early 1980s to improve process control. In fiscal year 1985 these units were used to demonstrate their ability to rapidly increase and decrease process inventory, which is a crucial factor in using nonfirm power. DOE estimates a cost of about \$60.8 million to install additional

²Firm power is the most expensive power a utility provides because it must be ready to supply the power at all times, even when maximum demand is made on the utility. Nonfirm power is less expensive because it is usually available intermittently for a few hours, although it may be available for a season or more. It is sold when, as, and if available and is subject to rapid termination.

freezer-sublimers at Paducah between fiscal years 1988 and 1993. DOE also plans to spend \$80.7 million to install transmission facilities so more inexpensive power can be brought to Paducah. The project is expected to begin in fiscal year 1988 and be completed by 1991.

Attempts to Contract for Low-Cost Power

The cost of operating the existing diffusion plants depends heavily upon the cost of electricity. The plants require large amounts of power because uranium hexafluoride gas has to be pumped through a large number of repetitive stages. Depending on the amount of enriched uranium being produced, electricity costs can represent 80 percent of production costs.

DOE currently has contracts with three suppliers of electrical power for the diffusion plants. Ohio Valley Electric Corporation supplies the Portsmouth plant; TVA is under contract to supply the Oak Ridge facilities and part of Paducah; Electric Energy Incorporated supplies the remainder of Paducah requirements. Ohio Valley Electric was formed in 1952 by 15 electrical companies to supply power to the Portsmouth plant; Electric Energy was established in 1951 by four sponsoring companies for the sole purpose of providing power to Paducah. DOE plans to use very little TVA power because of its high cost (34 mills/kwh) but has taken actions to ensure that low-cost power from other sources will continue to be available when needed.

In January 1987 DOE and Electric Energy Incorporated agreed to an extension of the current contract through the year 2005. Electric Energy Incorporated will continue to supply firm power at about the same price (25 mills/kwh) as under the current contract, adjusted for inflation. It will also sell DOE nonfirm power as required. DOE is revising the proposed contract extension and expects to send it to the Congress in the near future.

In addition, in June 1986 DOE requested expressions of interest to supply firm and nonfirm power for the Portsmouth plant. Four utilities responded, including the present supplier, Ohio Valley Electric. DOE determined that Ohio Valley Electric was the best provider for Portsmouth and is currently negotiating a contract extension. According to DOE, the firm power rates will remain about the same as under the current contract (18 mills/kwh), adjusted for inflation. DOE expects to send the Ohio Valley Electric contract to the Congress by the fall of 1987.

Requirements for a Government Corporation

Although we generally oppose the formation of new government corporations, we recognize that under certain conditions a government corporation is justified. The enrichment program meets many of the criteria generally believed to be conducive to corporate management. These include (1) performance of a business function requiring many transactions with the private sector, (2) the potential ability to be self-sustaining, and (3) the need for greater financial flexibility.

If a uranium enrichment corporation is formed, it should be a government corporation subject to the provisions of the Government Corporation Control Act (31 U.S.C. 9101 - 9109), which set forth audit, budget, and financial requirements. The corporation should be free to sue, be sued, hire, fire, raise and lower prices, and retain and allocate revenues. However, in order to promote prudent oversight and allow the President to coordinate policies applying to government enterprises, the corporation should prepare a business-type budget to be integrated with the administration's and submitted to the Congress as part of the U.S. budget. In those years when revenues are not expected to cover expenses, the expected shortfall should be provided for through the appropriations process. In addition, the corporation should report to the department or agency head—in this case the Secretary of Energy. The authorizing language for the corporation should also make it clear that we have comprehensive audit authority over the corporation's activities as specified in 31 U.S.C. 9105, and we have access to records to permit us to perform an effective audit.

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