

DOE/IG-0522

**AUDIT  
REPORT**

**THE PLUTONIUM IMMOBILIZATION PLANT  
AT THE SAVANNAH RIVER SITE**



SEPTEMBER 2001

U.S. DEPARTMENT OF ENERGY  
OFFICE OF INSPECTOR GENERAL  
OFFICE OF AUDIT SERVICES



**U. S. DEPARTMENT OF ENERGY**  
**Washington, DC 20585**

September 11, 2001

MEMORANDUM FOR THE SECRETARY

FROM: Gregory H. Friedman (Signed)  
Inspector General

SUBJECT: INFORMATION: Audit Report on "The Plutonium  
Immobilization Plant at the Savannah River Site"

BACKGROUND

In September 2000, the United States and the Russian Federation entered into an agreement stipulating that each country would irreversibly transform 34 metric tons of weapons-grade plutonium into forms that cannot be used for weapons purposes. As part of the United States' commitment, the Department of Energy has developed plans to dispose of 8.4 metric tons of the plutonium and convert 25.6 metric tons into mixed oxide reactor fuel. Both operations are to take place at the Savannah River Site (Site).

In developing a process to dispose of the 8.4 metric tons of weapons-grade plutonium covered by the agreement, as well as additional "weapons-usable" plutonium, the Department planned to immobilize the material by constructing a Plutonium Immobilization Plant (Plant) at the Site. The Plant is to accept plutonium and plutonium oxides and, through a ceramic immobilization process, convert the plutonium into mineral-like forms. Subsequently, this material is to be encapsulated within a canister of high-level radioactive glass. The estimated life-cycle cost of the immobilization project is about \$1.5 billion in constant Fiscal Year 2001 dollars.

Except for limited continuing research and development activities, the Department has suspended work on the Plant to provide additional funds for higher priority projects. The Governor of South Carolina announced that, based on the Department's actions, he was concerned that the strategy for disposing of plutonium being imported to the Site is being abandoned and that the Site could become a permanent plutonium dumping ground. The Department has stated that its overall strategy for disposing of surplus plutonium has not changed; however, it acknowledged that the program is under review, aspects of which are under the purview of the National Security Council.

The objective of this audit was to determine whether the proposed Plutonium Immobilization Plant duplicates a capability that already exists at the Savannah River Site.

## RESULTS OF AUDIT

The audit disclosed that the proposed Plant does not duplicate existing capabilities already operating at the Site. However, we determined that the Plant potentially overlaps with the capability of the Site's FB Line Facility (FB Line), and could duplicate the capability of another plant, the Treatment and Storage Facility (TSF), which is scheduled to be operational at the Site in September 2008. We noted that the Department's Office of Fissile Materials Disposition had not considered the FB Line or the TSF as alternatives for disposing of excess plutonium. Our analysis suggests that there could be very significant savings if the Department used existing or planned Site facilities, rather than building the Immobilization Plant. In fact, we concluded that the overall cost savings associated with the alternative approach could be in excess of \$650 million. Further, the FB Line and TSF may provide the Department with other alternatives to dispose of surplus plutonium and to satisfy the United States' commitment as part of the agreement with the Russian Federation.

## MANAGEMENT REACTION

Management concurred with the recommendation, but did not agree with the magnitude of the estimated cost savings presented in the report. Management contended that the proposed alternatives have not been developed to the stage that meaningful cost estimates can be established. It acknowledged, however, that the Department is now analyzing the FB Line as part of an ongoing assessment of the use of Site facilities for plutonium disposition. Management intends to complete this assessment in January 2002. Finally, we were told that a utilization study of the TSF will be started in October 2002 and completed about six months later.

Management's commitment to analyze the FB Line and the proposed TSF is responsive to our recommendation. We recognize that modifications to the FB Line and the TSF are necessary to accomplish plutonium disposition and that the exact cost savings associated with utilizing either of these facilities cannot be determined at this time. However, our analyses, based on the cost estimates available at the time of our audit, indicate that the FB Line and TSF offer significant potential cost savings when compared to constructing and operating the PIP.

cc: Deputy Secretary  
Under Secretary for Energy, Science and Environment  
Administrator, National Nuclear Security Administration  
Acting Director, Office of Fissile Materials Disposition

# THE PLUTONIUM IMMOBILIZATION PLANT AT THE SAVANNAH RIVER SITE

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# OVERVIEW

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## INTRODUCTION AND OBJECTIVE

In September 2000, the United States and the Russian Federation entered into an agreement stipulating that each country will irreversibly transform 34 metric tons of weapons-grade plutonium into forms unusable for weapons. The agreement states that disposition of the plutonium shall be by irradiation as fuel, immobilization, or any other methods approved by both countries. The agreement sets 2007 as the target to begin the disposition process. To meet the United States' commitment, the Department of Energy (Department) plans to dispose of 8.4 metric tons and convert 25.6 metric tons of weapons-grade plutonium into nuclear reactor fuel. The majority of the plutonium will be shipped to Savannah River from other Department facilities.

To dispose of the 8.4 metric tons of weapons-grade plutonium, the Department plans to construct a Plutonium Immobilization Plant (PIP) at the Savannah River Site. The PIP will accept plutonium and plutonium oxides and, through a ceramic immobilization process, convert the plutonium into mineral-like forms that will subsequently be encapsulated within a large canister of high-level radioactive glass. The PIP will have the capacity to process 13 metric tons of weapons-usable plutonium, including 8.4 metric tons of weapons grade plutonium. Based on the plant's capacity of 13 metric tons, the Department estimated the life-cycle cost of the project to be about \$1.5 billion in constant FY 2001 dollars. As of March 30, 2001, the Department had spent \$101 million on the project. However, except for two research and development activities in FY 2002, the Department has suspended funding on the project.

The objective of this audit was to determine whether the proposed PIP duplicates a capability that already exists at the Savannah River Site.

## CONCLUSIONS AND OBSERVATIONS

The proposed PIP does not duplicate a capability that exists at the Savannah River Site. However, it potentially overlaps with the capability of the site's FB Line Facility (FB Line), and could duplicate the capability of the planned Treatment and Storage Facility (TSF), scheduled to be operational at the site in September 2008. This occurred because the Department's Office of Fissile Materials Disposition did not consider the FB Line or TSF as alternatives for disposing of excess plutonium. The Department could potentially save at least \$654 million if existing or planned facilities are used, rather than building the PIP.

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The Office of Inspector General identified a similar situation at the Savannah River Site in May 1994. Report DOE/IG-0349, *Audit of the Uranium Solidification Facility at the Savannah River Site*, concluded that the Department continued to construct the Uranium Solidification Facility even though its need for processing liquid uranyl nitrate had significantly diminished. The audit identified more economical alternatives for processing existing quantities of liquid uranyl nitrate at the Savannah River Site. To its credit, the Department concurred with the audit finding and recommendation, and cancelled the construction project.

This audit identified significant issues that management should consider when preparing its year-end assurance memorandum on internal controls.

Signed  
Office of Inspector General

## ALTERNATIVE FACILITIES SHOULD BE EVALUATED

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### Alternatives for Disposing of Plutonium

The proposed PIP potentially overlaps with the capability of the FB Line, and could duplicate the capability of the TSF, which is scheduled to be operational in September 2008. According to Westinghouse Savannah River Company (Westinghouse) management, the FB Line could be modified to convert weapons-grade plutonium into a form that could be used to make fuel for nuclear reactors. Westinghouse has used the FB Line to convert scrap plutonium into a solid form by concentrating and purifying plutonium nitrate solutions from the F Canyon and reducing the plutonium to metal form. Therefore, the FB Line could be available for other uses in FY 2002, when its current mission is completed.

The TSF is another potential alternative for disposing of weapons-grade plutonium. Westinghouse is designing the TSF to use melt-and-dilute technology for the disposal of spent nuclear fuel, beginning in September 2008. The Savannah River Site Manager requested that Westinghouse evaluate whether nuclear materials other than aluminum-clad spent nuclear fuel should be considered for disposal using the melt-and-dilute process. Westinghouse completed its evaluation in February 2000, concluding that the melt-and-dilute process might be an alternative for the disposal of excess plutonium. Westinghouse recommended that the Department proceed with a study to substantiate the viability of disposing of other materials. The study, which would cost about \$300,000, would document whether plutonium and other metals were candidates for the melt-and-dilute process. However, the study has not been performed due to a lack of funds.

### Department's Cost Objective Was to Immobilize Plutonium Cost-Effectively

Department of Energy Order 430.1.A states that the Department, in partnership with its contractors, shall acquire physical assets in a safe and cost-effective manner to meet the Department's mission. While the principal objective is nonproliferation, the Department's cost objective for the immobilization project, as stated in the *Design-Only Conceptual Design Report Plutonium Immobilization Plant*, was to produce an immobilized form of plutonium that would be cost-effective, utilizing existing facilities and capabilities to the maximum extent practical.

In accordance with the Government Performance and Results Act of 1993, the Department has established performance measures for disposing of excess plutonium through immobilization. The measures involve the elimination of weapons useable plutonium within approximately 20 years by immobilization and irradiation as fuel.

**Alternatives Were Not Evaluated**

The Department's Office of Fissile Materials Disposition did not consider the capability of using the FB Line or the TSF to dispose of excess plutonium. In 1995, the Department evaluated 37 disposition options for plutonium. However, neither the FB Line nor the TSF was considered. The FB Line was not considered because of nonproliferation policy issues that have since been reassessed. The TSF was not considered because it was still in its pre-conceptual phase at the time of the study.

Analyzing these alternatives now will not delay the disposition of the plutonium because the Department has suspended funding for the PIP. In the interim, the Office of Defense Nuclear Nonproliferation has asked Westinghouse to reassess the use of Savannah River Site's Building 221-F for plutonium disposition because of its potential to reduce disposition costs. Building 221-F, one of the 37 alternatives that was previously evaluated by the Department, was found not to be cost-effective when compared to the life-cycle cost of the PIP.

**Using Existing or Planned Capabilities Could Result In Savings**

The Department could potentially save at least \$654 million by modifying and operating the FB Line or the TSF to dispose of surplus plutonium, rather than constructing and operating the PIP. The following chart summarizes our estimates of the cost savings. As the implementation of disposition requirements for plutonium are examined in more detail, the cost estimates could vary significantly from those presented here.

POTENTIAL SAVINGS (Millions of Dollars)			
Cost	PIP	Alternatives	
		FB Line	TSF
Facilities Cost	\$811	\$104	\$200
Operations Cost	<u>623</u>	<u>676</u>	<u>200</u>
Life Cycle Cost to Dispose of Plutonium	<u>\$1,434</u>	<u>\$780</u>	<u>\$400</u>
Savings (Alternatives Compared to PIP)		<u>\$654</u>	<u>\$1,034</u>

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### PIP

The Department's cost estimate to build the PIP is \$912 according to a March 30, 2001 draft report to Congress, of which \$101 million has already been spent. Thus, as shown in the previous chart, the cost to complete the facility is \$811 million. Operating costs to dispose of the plutonium in the PIP, which include decontamination and decommissioning costs, are estimated to be about \$623 million.

### FB Line

The cost to modify the FB Line for plutonium disposition is estimated to be about \$104 million. This is based on the Department's *Design-Only Conceptual Design Report* for the PIP, dated September 2000. The report contained \$74 million for site improvements and support facilities, and \$30 million in process facility costs for a new receipt-and-storage facility, modification to the Defense Waste Processing Facility, and a security upgrade.

Operating costs to dispose of plutonium in the FB Line are estimated to be \$676 million. Westinghouse management stated that the operating costs of the FB Line for the first 6 months of FY 2001 were about \$26 million, or about \$52 million annualized. Also, management stated that the FB Line could process about one metric ton of plutonium per year. Thus, disposal of 13 metric tons, including the 8.4 metric tons of weapons-grade plutonium in the agreement with the Russian Federation, would take about 13 years.

### TSF

Westinghouse estimated that it would cost an additional \$200 million to modify the TSF to process 13 tons of excess plutonium. Currently, the design and construction of the TSF is estimated to cost about \$300 million. We estimated the operating costs to dispose of plutonium in the TSF to be about \$200 million, based on annual operating costs of \$20 million for 10 years, beginning by September 2008.

As previously stated, the cost estimates to modify the FB Line and TSF to dispose of plutonium could change significantly as the implementation of plutonium disposition requirements are further examined. Nonetheless, our analyses of the estimates show that the Department should evaluate the FB Line and TSF to ensure that plutonium disposition is cost-effective and utilizes existing facilities and capabilities to the maximum extent practical.

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**RECOMMENDATION**

We recommend that the Acting Director, Office of Fissile Materials Disposition, analyze the FB Line and the proposed TSF as alternatives to constructing the PIP.

**MANAGEMENT REACTION**

Management concurred with the recommendation, but did not agree with the magnitude of the estimated cost savings because the proposed alternatives have not been developed to the stage that meaningful cost estimates can be established. Management, did note, however, that it is now analyzing the FB Line as part of an ongoing assessment of the use of Savannah River Site facilities for plutonium disposition. Management intends to complete this assessment in January 2002. The TSF utilization study will be started in October 2002 and completed about six months later.

**AUDITOR COMMENTS**

Management's commitment to analyze the FB Line and the proposed TSF is responsive to our recommendation. We acknowledge that modifications to the FB Line and the TSF are necessary to accomplish plutonium disposition and that the exact cost savings associated with utilizing either of these facilities cannot be determined at this time. However, our analyses, based on the cost estimates available at the time of our review, indicate that the FB Line and TSF offer significant potential cost savings when compared to constructing and operating the PIP. More importantly, these facilities may provide the Department with other alternatives to dispose of surplus plutonium and satisfy the United States' commitment to the Russian Federation.

# Appendix

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## SCOPE

The audit was performed from November 28, 2000, to August 13, 2001, at the Savannah River Site near Aiken, South Carolina and Headquarters, Washington, D.C. The audit covered a review of the Department's planned Plutonium Immobilization Plant (PIP).

## METHODOLOGY

To accomplish the audit objective, we:

- Reviewed the United States-Russian Federation Agreement concerning the disposition of plutonium designated as no longer required for defense purposes;
- Reviewed the following documents pertaining to the PIP:
  - Department of Energy Record of Decision for the Storage and Disposition of Weapons-Useable Fissile Material Final Programmatic Environmental Impact Statement;
  - Design-only conceptual design reports;
  - Development and testing baseline and progress monthly reports;
  - Integrated technology development plans; and,
  - Various cost studies performed for the Department.
- Reviewed the evaluation of feeds for the melt-and-dilute process performed by Westinghouse as it relates to the planned Treatment and Storage Facility;
- Interviewed Westinghouse and Department managers regarding the proposed PIP and the use of the FB Line and Building 221-F for the disposition of excess plutonium; and,
- Estimated the savings associated with using existing or proposed facilities rather than building the PIP.

The audit was performed in accordance with generally accepted Government auditing standards for performance audits and included tests of internal controls and compliance with laws and regulations to the extent necessary to satisfy the audit objective. Accordingly, the assessment included reviews of Departmental and contractor policies, procedures, and performance measures related to the management and control of the plan and design for the PIP. Because our review was limited, it would not necessarily have disclosed all internal control

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of the plan and design for the PIP. Because our review was limited, it would not necessarily have disclosed all internal control deficiencies that may have existed at the time of our audit. We did not rely upon computer-generated data for the purposes of this audit.

We held an exit conference with the Director, Materials and Immobilization Group, Office of Fissile Materials Disposition, on August 16, 2001.

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