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**Department of Energy**  
Washington, DC 20585

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November 1, 2001

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DNF SAFETY BOARD

The Honorable John T. Conway  
Chairman  
Defense Nuclear Facilities Safety Board  
625 Indiana Avenue, NW  
Washington, D.C. 20004

Dear Mr. Chairman:

The purpose of this letter is to inform you that three actions identified in the Implementation Plan for Recommendation 2001-1, High-level Waste Management at the Savannah River Site, were completed by the Department of Energy (DOE) in October 2001. The three completed actions are:

1. Commitment 2.2—Issue Record of Decision (ROD) on Salt Processing Alternatives—October 2001. The Assistant Secretary for Environmental Management signed the ROD for Salt Processing Alternatives on October 9, 2001, and it was published in the *Federal Register* on October 17, 2001. A copy of the ROD is enclosed. (Enclosure 1)
2. Commitment 3.3—Tank 49 Available for High-Level Waste (HLW) service—October 2001. Tank 49 was available for HLW service on October 11, 2001, upon implementation of the revised Authorization Basis.
3. Commitment 3.6—Return 2H evaporator to Operations—November 2001. The DOE Savannah River Manager approved restart of the 2H evaporator on October 5, 2001, and feeding of waste into the evaporator pot was initiated later the same day. (Enclosure 2)

The Department continues to work safely to restore a level of operational margin in the Savannah River Tank Farms, and these actions are steps toward this goal. If you have any questions, please contact me at (202) 586-7710.

Sincerely,

Paul Golan  
Chief of Staff  
Office of Environmental Management

Enclosures



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**DEPARTMENT OF ENERGY****Record of Decision: Savannah River Site Salt Processing Alternatives****AGENCY:** Department of Energy (DOE)**ACTION:** Record of Decision

**SUMMARY:** The Savannah River Site Salt Processing Alternatives Supplemental Environmental Impact Statement (Salt Processing SEIS, DOE/EIS-0082-S2) considered alternatives for separating the high-activity fraction from the low-activity fraction of the high-level radioactive salt waste now stored in underground tanks at the Savannah River Site (SRS) near Aiken, South Carolina. Based on the analysis in the SEIS and the results of laboratory scale research and development and independent reviews, DOE determined that any of the alternatives evaluated could be implemented with only small and acceptable environmental impacts. DOE has decided to implement Caustic Side Solvent Extraction for separation of radioactive cesium from SRS salt wastes because the solvent extraction process is robust and efficient, and DOE has experience with similar solvent extraction processes such as PUREX (Plutonium – Uranium Extraction).

Initial implementation of the Caustic Side Solvent Extraction technology will consist of designing, constructing, and operating a facility in S-Area. DOE will evaluate the processing capacity needed based on high-level waste system requirements (including, but not limited to, waste removal capabilities, optimization of salt-sludge blending for Defense Waste Processing Facility operations, and saltstone system modifications or upgrades), projected throughput, and conceptual design data. Based on these evaluations, DOE may elect to build a facility or facilities to carry out the Caustic Side Solvent Extraction process that could accommodate pilot program and production objectives, but would not exceed the size or processing capacity evaluated in the Salt Processing SEIS. In parallel,

DOE will evaluate implementation of any of the other salt processing alternatives for specific waste portions for which processing could be accelerated or that could not be processed in the Caustic Side Solvent Extraction facility. These evaluations and potential operations would be undertaken to maintain operational capacity and flexibility in the HLW system, and to meet commitments for closure of high-level waste tanks.

**ADDRESSES:** Copies of the Salt Processing SEIS and this Record of Decision may be obtained by calling a toll free number (800-881-7292), by sending an e-mail request to [nepa@srs.gov](mailto:nepa@srs.gov) or by mailing a request to: Andrew Grainger, National Environmental Policy Act (NEPA) Compliance Officer, Savannah River Operations Office, Department of Energy, Building 742A, Room 185, Aiken, SC 29808. The SRS Salt Processing Alternatives SEIS (including the 38-page Summary) is available on the Department of Energy NEPA Web site, [us.eh.doe.gov/nepa/docs/docs.htm](http://us.eh.doe.gov/nepa/docs/docs.htm). This Record of Decision also will be available at the above Web site.

**FOR FURTHER INFORMATION CONTACT:** Questions concerning the SRS Salt Processing program can be submitted by calling 800-881-7292, mailing them to Mr. Andrew Grainger at the above address, or sending them electronically to the Savannah River Operations Office e-mail address, [nepa@srs.gov](mailto:nepa@srs.gov).

For general information on the DOE NEPA process, please contact: Carol M. Borgstrom, Director, Office of NEPA Policy and Compliance, U.S. Department of Energy, 1000 Independence Avenue, S.W., Washington, DC 20585, 202-586-4600 or leave a message at 800-472-2756.

#### **SUPPLEMENTARY INFORMATION:**

##### **Background**

Nuclear materials production operations at the SRS resulted in the generation of large quantities of high-level radioactive waste (HLW), which is stored onsite in large underground tanks. SRS HLW was generated as an acidic solution and was chemically converted to an alkaline solution for storage. In its alkaline form it consists of two components, soluble salt and insoluble sludge. Both components contain highly radioactive residues from nuclear materials production. Radionuclides found in the sludge component include fission products (such as strontium-90) and long-lived actinides (such as uranium and plutonium). Radionuclides found in the soluble salt component

include isotopes of cesium and technetium, as well as some strontium and actinides. DOE has been operating the Defense Waste Processing Facility (DWPF) since 1996 to vitrify (convert to glass) the sludge component of HLW to a stable form suitable for disposal in a geologic repository.

DOE continues to manage the salt component within the HLW tank system. Dewatering the salt solution by evaporation, a process that conserves tank space, converts the salt solution to a solid saltcake and a concentrated salt supernatant. In order to process the salt component using any action alternative described in the Salt Processing SEIS, DOE must first convert the saltcake back to salt solution. Solid saltcake would be dissolved by adding water and combined with salt supernatant to form a salt solution. The highly radioactive constituents would be separated from the salt solution and vitrified in DWPF. The remaining low-activity constituents, consisting mostly of non-radioactive salts, would be stabilized with grout (a cement-like mixture) to create a saltstone waste form for disposal at the SRS as low-level radioactive waste.

DOE evaluated the potential environmental impacts of constructing and operating DWPF in a 1982 EIS (DOE/EIS-0082). In 1994 DOE published a SEIS (DOE/EIS-0082-S) evaluating changes in the HLW process proposed after the 1982 EIS was issued. The Record of Decision (60 FR 18589; April 12, 1995) announced that DOE would complete the construction and startup testing of DWPF using the In-Tank Precipitation (ITP) process to separate the high-activity fraction from the salt solution.

DOE designed the ITP process to be carried out primarily in one of the underground HLW storage tanks. Under the ITP process an inorganic sorbent, monosodium titanate, would have removed actinides and radioactive strontium from the salt solution and an organic reagent, sodium tetraphenylborate, would have precipitated radioactive cesium from the salt solution. The ITP process included washing and filtration steps to separate the resulting solids and residual sludge for vitrification in DWPF. However, tetraphenylborate is subject to catalytic and radiolytic decomposition that returns cesium to the salt solution and generates benzene, which is a toxic, flammable, and potentially explosive organic substance that must be safely controlled. The ITP process was designed to accommodate some tetraphenylborate decomposition and to limit benzene accumulation. To achieve the objectives of the ITP process, however, the decomposition of tetraphenylborate must be limited to minimize (1) the amount of

precipitated cesium that is redissolved in the salt solution and (2) the amount of benzene generated. Startup testing of the ITP facility in 1995 generated benzene in much greater quantities than had been anticipated based on calculations and laboratory experiments, and ITP startup operations were suspended in order to develop a better understanding of the ITP process chemistry.

In August 1996, the Defense Nuclear Facilities Safety Board (DNFSB), chartered by Congress to independently review operations at DOE nuclear defense facilities and to make recommendations necessary to protect public health and safety, recommended that planned large-scale testing of the ITP process not proceed further until DOE had a better understanding of how benzene was generated and released during the precipitation process. In response to the DNFSB recommendation, DOE initiated an extensive chemistry program to better understand the process of benzene generation and release. In January 1998, DOE determined that ITP, as designed, could not meet production goals and safety requirements, because the separation of radionuclides from HLW salt solution could not be achieved without excessive tetraphenylborate decomposition and benzene generation. DOE must therefore select an alternative technology for HLW salt processing.

### **Alternative Technology Evaluation**

Westinghouse Savannah River Company (WSRC), the SRS operating contractor, evaluated a list of over 140 potential salt treatment technologies to replace the ITP process and in October 1998 recommended four technologies for further consideration: Small Tank Tetraphenylborate Precipitation (Small Tank), Crystalline Silicotitanate Ion Exchange (Ion Exchange), Caustic Side Solvent Extraction (Solvent Extraction), and Direct Disposal in Grout (Direct Disposal). DOE decided in early 1999 to pursue three of the four candidate alternatives for replacement of the ITP process, dropping Solvent Extraction because it was considered technically immature for the salt waste at that time.

In addition to engineering and research and development efforts, reviews by the National Academy of Sciences have played an important role in reviewing DOE's technology selection process. In June 1999 the Under Secretary of Energy requested that the National Academy of Sciences – National Research Council provide an independent technical review of alternatives for processing the HLW salt at the SRS. In response to the request, the Council

appointed a "Committee on Cesium Processing Alternatives for High-Level Waste at the Savannah River Site," which conducted a review and provided an interim report in October 1999 and a final report in August 2000. Based on that report's recommendation and new research and development results from independent work at Oak Ridge National Laboratory, DOE restored Solvent Extraction to the list of potential alternatives. In connection with the August 2000 report, DOE asked the Council to provide a follow-on assessment, and the Council appointed a "Committee on Radionuclide Separation Processes for High-Level Waste at the Savannah River Site" in October 2000 to review DOE's evaluation of potential technologies for separating radionuclides from soluble high-level radioactive waste at the SRS. This second committee conducted its review and provided an interim report in March 2001 and a Final Report in June 2001. The report concluded that Caustic Side Solvent Extraction technology presents the least technical uncertainties of any of the three cesium separation alternatives.

#### **Alternatives Considered**

The Salt Processing SEIS describes the environmental impacts of the four salt processing technology alternatives that were evaluated through engineering and research and development efforts and independent technical reviews. The four salt processing technology alternatives considered in the Salt Processing SEIS were Small Tank, Ion Exchange, Solvent Extraction, and Direct Disposal. The analysis in the Salt Processing EIS is based on pre-conceptual engineering designs of the facilities and emissions estimates generated from knowledge of chemical processes and engineering controls that would be applied. The Salt Processing SEIS also analyzed a No Action alternative (i.e., a continuation of current HLW management activities).

The four salt processing technology alternatives considered in the Salt Processing SEIS share some common features. Each alternative includes initial separation of low-concentration soluble radioactive strontium and actinides (including plutonium) by sorption, followed by filtration. The essential difference among the alternatives is the technology for removal of the relatively high concentrations of radioactive cesium. Except for the Direct Disposal alternative, in which cesium would not be removed but would remain in the fraction immobilized as saltstone for disposal at the SRS, the final waste forms are similar for each of the action alternatives. For these action alternatives the cesium is extracted from the salt solution and incorporated into a vitrified waste form for

eventual repository disposal, and the remaining low-activity salt fraction is immobilized as saltstone for disposal at the SRS.

### **Solvent Extraction**

The Solvent Extraction alternative, identified as the preferred alternative in the final Salt Processing SEIS, would use a highly specific organic extractant to separate cesium from the HLW salt solution. The cesium would be transferred from the aqueous salt solution into an insoluble organic phase, using a centrifugal contactor to provide high surface area contact, followed by centrifugal separation of the two phases. Recovery of the cesium by back extraction from the organic phase into a secondary aqueous phase would generate a concentrated cesium solution for vitrification in DWPF.

### **Small Tank Precipitation**

The Small Tank Precipitation alternative would use tetraphenylborate precipitation, the same chemical reaction as in ITP, to remove the radioactive cesium from the HLW salt solution. The process would be conducted as a continuous operation using a small, temperature-controlled reaction vessel to inhibit tetraphenylborate decomposition and benzene generation. The vessel and operating conditions would be designed to minimize benzene emission and flammability hazards by maintaining an inert gas (i.e., nitrogen) atmosphere within the reaction vessel. DOE learned from the ITP process experience that temperature control and maintenance of an inert atmosphere are important for safe and efficient tetraphenylborate precipitation.

### **Ion Exchange**

The Ion Exchange alternative would use crystalline silicotitanate resin in ion exchange columns to separate cesium from the salt solution. The salt solution would be passed through large stainless steel ion exchange columns filled with the ion exchange resin to react the cesium with the resin. Treatment of the solution to separate strontium and actinides, followed by filtration to remove the solids and residual sludge, would be necessary prior to separating the cesium to prevent plugging the ion exchange columns.

The Ion Exchange process would result in the accumulation of as much as 15 million curies of radioactive cesium on the resin inventory within the process cell. This radioactive loading would require stringent shielding and operational controls because of high radiation, high heat generation, and the generation of hydrogen and other gases.

### **Direct Disposal in Grout**

As indicated earlier in this section, under the Direct Disposal alternative the HLW salt solution would be disposed of at SRS as saltstone, without prior separation of radioactive cesium. The resulting saltstone would have radionuclide concentrations less than Class C low-level waste (LLW) limits, but would exceed Class A limits, as defined in U.S. Nuclear Regulatory Commission (NRC) regulations at 10 CFR 61.55. These waste classifications do not apply to DOE-generated LLW, but DOE used the NRC classification system in the Salt Processing SEIS to describe differences in waste forms because DOE Manual 435.1-1 establishes a process for making waste-incident-to-reprocessing determinations in terms of the NRC classifications. The current Saltstone Facility permit, which was issued by the South Carolina Department of Health and Environmental Control (SCDHEC) under its State wastewater authority, authorizes disposal of wastes with radionuclide concentrations comparable to Class A LLW. Under the permit, DOE must notify SCDHEC if the characteristics of wastes in saltstone vaults would change, as would be the case with the higher level of radioactivity in the final waste form under the Direct Disposal alternative. Also, if this alternative were implemented, cesium would not be present in sufficient concentrations in DWPF canisters to make the canisters "self-protecting." This characteristic would be necessary for DOE to carry out immobilization of certain plutonium materials, as described in the Surplus Plutonium Disposition EIS (DOE/EIS-0283) and the associated Record of Decision (65 FR 1608; January 11, 2000).

### **No Action**

Under the No Action alternative in the near term, DOE would continue current HLW management activities, including tank space management, without a process for separating the high-activity from the low-activity salt fractions. DWPF would vitrify only sludge from the HLW tanks. Saltcake and salt supernatant would be stored in the HLW tanks and monitoring activities would continue. DOE would continue to manage tank space to ensure adequate space to meet safety requirements and closure commitments. Current tank space management projections



indicate that additional tank space would be needed after 2010 to support continuing operations under the No Action alternative.

Without a salt processing technology in place, however, current HLW storage operations could not continue indefinitely. DWPF operations result in large volumes of waste, mostly water, which is returned to the HLW tanks. DOE uses evaporators to substantially reduce this volume, but until a salt processing technology is on-line, DWPF operation will increase rather than decrease the volume of HLW that must be stored in the tanks.

#### **Environmentally Preferable Alternative**

Ion Exchange is the environmentally preferable alternative. Review of the data presented in the Salt Processing SEIS shows that the construction and operation activities to implement the Ion Exchange alternative would have impacts that are generally small and similar to the other action alternatives. However, because the Ion Exchange alternative does not use organic materials that generate organic compounds (such as benzene) that must be treated, there are no organic emissions that must be managed. Organic compounds used in the Solvent Extraction and Small Tank alternatives result in organic emissions that must be safely managed. Also, certain accidents involving volatile organic compounds could not occur with the Ion Exchange alternative. Ion Exchange would result in the lowest radiological dose to the worker population and the public, although none of the alternatives would result in adverse health effects from radiological releases during construction and normal operation.

The No Action alternative is the least desirable both in the short term, because of the impacts of construction and operation of new HLW tanks, and in the long term because of the unacceptably high quantity of HLW contaminants that could be released to onsite streams.

In the short term the Direct Disposal alternative would in many cases generate the least effluents of any of the processing alternatives. However, in the long term Direct Disposal would release greater quantities of contaminants to the environment than would the other processing alternatives because of the much greater concentration of cesium that would be disposed of in saltstone. For this reason Direct Disposal cannot be considered the environmentally preferable alternative.

### **Comments on the Final Supplemental EIS**

On July 30, 2001, the Defense Nuclear Facilities Safety Board (DNFSB) commented on DOE's identification of the Solvent Extraction alternative as the preferred technology for processing salt waste at SRS. DNFSB urged DOE to pursue a back-up technology through pilot scale operations to give DOE more flexibility in addressing unforeseen technical or programmatic issues. The DNFSB letter identified the Small Tank Precipitation alternative as an apparently appropriate back-up technology. The DNFSB letter also stated the belief that DOE would benefit from further assessment of direct disposal of low-source-term wastes. In an August 24, 2001, response to the DNFSB letter, DOE expressed appreciation for the DNFSB's perspective on the technologies and associated technical challenges, and pledged to continue to work closely with the DNFSB and its staff to communicate the bases of the DOE approach as well as progress on assuring that the project proceeds safely and effectively. DOE will continue laboratory testing of the other technologies in support of potential future needs as a backup technology and as potential technologies for processing specific portions of the HLW until such time as a Solvent Extraction facility is operational and has proven successful.

By letter dated August 15, 2001, the United States Environmental Protection Agency, Region 4 (EPA) commented on the Final Salt Processing SEIS. EPA stated that the disposal routes and locations for secondary waste streams, including low-level waste that would be generated from the Small Tank and Solvent Extraction technologies, were not discussed clearly in the EIS. On June 28, 2001, DOE published an Amended Record of Decision (66 FR 34431) for the SRS Waste Management EIS (DOE/EIS-0217, July 1995), announcing DOE's decision to ship certain SRS low-level and low-level mixed waste streams offsite for treatment and disposal at commercial or Government facilities. DOE will select among the disposal options considered in the SRS Waste Management EIS, depending upon the volume and characteristics of the salt processing alternative waste stream, and the costs of treatment and disposal. The Final Salt Processing SEIS acknowledges the possibility of offsite treatment or disposal for certain waste streams, but at this time DOE cannot be more specific about which disposal options would eventually be chosen.

EPA requested clarification on the current viability of the Consolidated Incineration Facility and other options for treatment of mixed low-level waste. As is explained on page 1-4 of the Final Salt Processing SEIS, DOE expects to decide whether to resume CIF operations by April 2002. DOE is investigating alternatives to incineration and will not operate the CIF if an effective alternative disposition of PUREX solvents can be identified.

## **Decision**

DOE has decided to implement Caustic Side Solvent Extraction for separation of radioactive cesium from SRS salt wastes. The results of research and development activities were an important factor in DOE's selection of a salt processing technology. DOE has performed research on each of the three cesium removal technology alternatives since 1998. Independent scientists and subject matter experts have reviewed the results of the research and assessed the advantages and disadvantages associated with each of the identified alternatives, considering life cycle costs and schedules for the design, construction, and operation of each alternative. In addition to, and in consideration of this research, analysis, and independent review, DOE conducted a final management review that comparatively evaluated each of the action alternatives against a list of criteria that included cost, schedule, technical maturity, implementability, environmental impacts, facility interfaces, process simplicity, process flexibility, and safety.

Although Solvent Extraction uses a complex four-component solvent system, laboratory testing has clearly shown that component concentration and process flow can be maintained to effectively remove cesium from the wastes. Other key strengths identified for the Solvent Extraction technology include: (1) maturity of and experience within the DOE complex for solvent extraction processing of nuclear material, (2) simplicity with which the Solvent Extraction product stream could be incorporated into the current DWPF vitrification process, and (3) the ability to rapidly start up and shut down the Solvent Extraction centrifugal contactors, which lends flexibility by allowing responsiveness to processing contingencies elsewhere in the HLW management system. DOE believes the Solvent Extraction process to be robust and efficient. In addition, DOE has extensive experience at the SRS with a similar solvent extraction process, Plutonium – Uranium Extraction (PUREX). The PUREX process has been used in F- and H-Canyons at SRS for almost 50 years to extract plutonium and uranium from solutions created by the dissolution of nuclear fuel and targets.

In addition to engineering and research and development efforts, the National Academy of Sciences has played an important role in evaluating DOE's technology selection process. In June 1999 the Under Secretary of Energy requested that the National Academy of Sciences – National Research Council provide an independent technical review of alternatives for processing the HLW salt at the SRS. In response to the request, the Council appointed a "Committee on Cesium Processing Alternatives for High-Level Waste at the Savannah River Site," which conducted a review and provided an interim report in October 1999 and a final report in August 2000. Based on that report's recommendation and new research and development results from independent work at Oak Ridge National Laboratory, DOE restored Solvent Extraction to the list of potential alternatives. In connection with the August 2000 report, DOE asked the Council to provide a follow-on assessment, and the Council appointed a "Committee on Radionuclide Separation Processes for High-Level Waste at the Savannah River Site" in October 2000 to review DOE's evaluation of potential technologies for separating radionuclides from soluble high-level radioactive waste at the SRS. This second committee conducted its review and provided an interim report in March 2001 and a Final Report in June 2001. The report concluded that Caustic Side Solvent Extraction technology presents the least technical uncertainties of any of the three cesium separation alternatives.

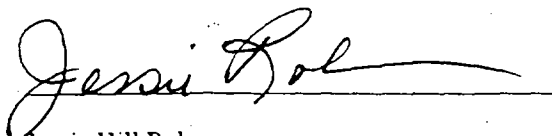
Initial implementation of the Caustic Side Solvent Extraction technology will consist of designing, constructing, and operating a facility in S-Area. DOE will evaluate the processing capacity needed based on the high-level waste system requirements (including, but not limited to, waste removal capabilities, optimization of salt-sludge blending for Defense Waste Processing Facility operations, and Saltstone system modifications or upgrades), projected throughput, and conceptual design data. Based on these evaluations, DOE may elect to build a Caustic Side Solvent Extraction process facility or facilities that could accommodate pilot program and production objectives, but would not exceed the size or processing capacity evaluated in the Salt Processing SEIS. In parallel, DOE will evaluate implementation of any of the other salt processing alternatives for specific waste portions for which processing could be accelerated or that could not be processed in the Solvent Extraction facility. These evaluations and potential operations would be undertaken to maintain operational capacity and flexibility in the HLW system, and to meet commitments for closure of high-level waste tanks.

The analysis in the Salt Processing SEIS shows that the environmental impacts of the construction and operation of a full-scale Solvent Extraction facility would be generally small and similar to those of the other processing alternatives. DOE determined that any of the alternatives evaluated could be implemented with only small and acceptable environmental impacts. The EIS estimates that the radiation doses for any of the alternatives would result in a small increase in latent cancer fatalities in the worker population and the offsite public, but would be well below applicable standards for both populations. The Solvent Extraction alternative would generate up to 900,000 gallons per year of radioactive liquid waste. Most of this volume consists of water that would be evaporated, and the remainder would be treated at the SRS Effluent Treatment Facility to remove radioactive substances and discharged as water meeting drinking water standards. The long term (after mission completion and facility decommissioning) effect on groundwater quality from residual radionuclides released from the saltstone vaults would be small and similar for the cesium separation alternatives, and greater, but still small, for the Direct Disposal alternative.

#### **Mitigation**

DOE is committed to environmental stewardship and to operating the SRS in compliance with all applicable laws, regulations, DOE Orders, permits, and compliance agreements. Construction and operation of the salt processing facility will be conducted in accordance with good engineering practice that includes measures to minimize the risks associated with the construction and operation of any industrial facility. DOE considers these to be standard operating procedures that do not require a mitigation action plan (under 10 CFR Part 1021.331(a)).

Issued at Washington, DC, October 9, 2001



Jessie Hill Roberson

Assistant Secretary for Environmental Management

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Enclosure 2

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01 OCT - 9 AM 10:57

OCT 05 2001

Mr. Robert A. Pedde, President  
Westinghouse Savannah River Company  
Aiken, SC 29808

Dear Mr. Pedde:

SUBJECT: Approval to Restart the 2H Evaporator

Reference: Letter, Pedde to Rudy, "HLW 2H Evaporator Request for Restart Authorization,"  
WSRC-2001-00048, 10/5/2001

The U. S. Department of Energy (DOE) – Savannah River Operations Office (SR) approves your request to restart the 2H evaporator. This approval is based on the results of the DOE Operational Readiness Review and my own staff's review of facility readiness. Enclosed is the approved Authorization Agreement that allows resumption of high level waste feed material into the 2H evaporator.

Sincerely,

Original Signed by  
Greg Rudy

Greg Rudy  
Manager

OD:CAE:kl

PD-02-003

Enclosure:  
Authorization Agreement

bcc: C. A. Everatt, OD  
AMHLW Rdg File  
OD Rdg File  
ECAT- 013493