Implementing RCRA During Facility Deactivation

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Project Hanford Management Contractor for the
U.S. Department of Energy under Contract DE-AC06-96RL13200

Copyright License By acceptance of this article, the publisher and/or recipient acknowledges the
U.S. Government's right to retain a nonexclusive, royalty-free license in and to any copyright covering this paper.

Approved for public release; distribution is unlimited
**IMPLEMENTING RCRA DURING FACILITY DEACTIVATION**

**I. Title of Journal:**

**2. Budget & Reporting Code:** B&R - KP51G EW7050000

**C. Date of Conference or Meeting:** SEPT 7, 1997

**D. City/State:** KNOXVILLE, TN

**E. Group of Society Sponsor:** AMERICAN NUCLEAR SOCIETY

**F. Will material be published in proceedings?** Yes

**G. Person Responsible:**

- C. Willingham
- L. Rogers
- S. L. Snyder

**H. Date Responsible:**

- 15-12-97
- 5-12-97
- 5-12-97

**I. Secretariat:**

**J. Date Approved:** 2-12-97

**K. Date Disapproved:**

**L. Date Canceled:**
10. LEGEND/STICKER MARKINGS (Required by WHS/OMS-4 orReviewer; Reviewer indicates applicable marking to be applied or removed)

<table>
<thead>
<tr>
<th>Category</th>
<th>Area</th>
<th>Sample</th>
<th>Initials</th>
<th>Approval</th>
<th>Remarks</th>
<th>Initials</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applied Technology</td>
<td>☐</td>
<td>☐</td>
<td></td>
<td>☐</td>
<td>☐</td>
<td></td>
</tr>
<tr>
<td>Availability - OSTI</td>
<td>☐</td>
<td>☐</td>
<td></td>
<td>☐</td>
<td>☐</td>
<td></td>
</tr>
<tr>
<td>Availability - EST3C</td>
<td>☐</td>
<td>☐</td>
<td></td>
<td>☐</td>
<td>☐</td>
<td></td>
</tr>
<tr>
<td>Availability - NTIS</td>
<td>☐</td>
<td>☐</td>
<td></td>
<td>☐</td>
<td>☐</td>
<td></td>
</tr>
<tr>
<td>Business-Sensitive Information</td>
<td>☐</td>
<td>☐</td>
<td></td>
<td>☐</td>
<td>☐</td>
<td></td>
</tr>
<tr>
<td>Computer Software Notice</td>
<td>☐</td>
<td>☐</td>
<td></td>
<td>☐</td>
<td>☐</td>
<td></td>
</tr>
<tr>
<td>Copyright License Notice</td>
<td>☑</td>
<td>☐</td>
<td></td>
<td>☑</td>
<td>☑</td>
<td></td>
</tr>
<tr>
<td>Export Controlled Information</td>
<td>☐</td>
<td>☐</td>
<td></td>
<td>☐</td>
<td>☐</td>
<td></td>
</tr>
<tr>
<td>Legal Disclaimer</td>
<td>☐</td>
<td>☐</td>
<td></td>
<td>☐</td>
<td>☐</td>
<td></td>
</tr>
<tr>
<td>Limited Disclosure</td>
<td>☐</td>
<td>☐</td>
<td></td>
<td>☐</td>
<td>☐</td>
<td></td>
</tr>
</tbody>
</table>

11. MANDATORY COMMENTS (Only mandatory comments here. All other comments shall be made on the document and returned to the author.)

<table>
<thead>
<tr>
<th>Reviewer (Print &amp; Sign)</th>
<th>Date</th>
<th>Received by Author/Requestor (Print &amp; Sign)</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

12. ADDITIONAL INFORMATION/COMMENTS:

___________________________________________________________________________

___________________________________________________________________________

___________________________________________________________________________

___________________________________________________________________________
Implementing RCRA During Facility Deactivation

G. J. LeBaron
J. P. Hayfield, Jr.
B&W Hanford Company

Date Published
May 1997

To Be Presented at
1st Topical Meeting on D&D
American Nuclear Society
Knoxville, Tennessee
September 7, 1997

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Copyright License By acceptance of this article, the publisher and/or recipient acknowledges the
U.S. Government's right to retain a nonexclusive, royalty-free license in and to any copyright covering this paper.

Approved for public release; distribution is unlimited
LEGAL DISCLAIMER
This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, nor any of their contractors, subcontractors or their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or any third party's use or the results of such use of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof or its contractors or subcontractors. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

This report has been reproduced from the best available copy.

Printed in the United States of America

DISCLM-2.CHP (1-91)
ADDRESSING RCRA DURING FACILITY DEACTIVATION

Gregory J. LeBaron
MSIN S6-19
B&W Hanford Company
P.O. Box 1200
Richland, WA 99352-1200

John P. Hayfield Jr.
MSIN S6-15
B&W Hanford Company
P.O. Box 1200
Richland, WA 99352-1200

ABSTRACT

RCRA regulations require closure of permitked treatment, storage and disposal (TSD) facilities within 180 days after cessation of operations, and this may essentially necessitate decommissioning to complete closure. A more cost effective way to handle the facility would be to significantly reduce the risk to human health and the environment by taking it from its operational status to a passive, safe, inexpensive-to-maintain surveillance and maintenance condition (deactivation) prior to decommissioning.

This paper presents an innovative approach to the cost effective deactivation of a large, complex chemical processing facility permitted under RCRA. The approach takes into account risks to the environment posed by this facility in comparison to risks posed by neighboring facilities at the site. The paper addresses the manner in which: 1) stakeholders and regulators were involved; 2) identifies a process by which the project proceeds and regulators and stakeholders were involved; 3) end points were developed so completion of deactivation was clearly identified at the beginning of the project; and 4) innovative practices were used to deactivate more quickly and cost effectively.

I. SUMMARY

The DOE has responsibility for thousands of facilities across the nation, many of which are no longer needed or are at the end of their useful lives. Facilities in which dangerous waste has been treated, stored or disposed have to be closed in accordance with multiple regulations. However, it may be in the best interest to deactivate facilities and postpone closure so resources can be directed toward other, higher risk facilities. There are several key principles that should be considered during the transition to deactivation (deactivation) of a complex facility subject to many of the dangerous waste and environmental regulations.

Key principles dealing with RCRA during a facility deactivation include:

If possible, identify that a facility will be deactivated before the final operation so product materials can be completely processed, systems flushed and wastes disposed of as part of the final operation. If not possible, as a minimum, consolidate wastes and dispose of them before they become dangerous waste in storage, requiring additional permitting.

Involve the regulators early by: 1) helping them understand the capabilities and limitations of the facility; 2) developing an open and honest relationship with them; 3) showing the benefits of deactivation activities that are in everybody's interest to achieve; and 4) involving them in the decision making.

Develop and agree with the regulators and the stakeholders on a process to be used for handling a facility through disposition.

Devote sufficient time and effort to developing end points so that objectives of the different stakeholders are addressed, the proper level of resources are used in deactivation, and it is clear when the deactivation effort is complete and the facility is ready to enter the low cost, low risk surveillance and maintenance phase.

Let people working at the facility know about the forthcoming challenges and encourage innovative ideas.

Involve the regulators as the direction of the deactivation plans change and clearly identify the benefits of the change.

Use experienced people and lessons learned from other facilities to be more cost effective in conducting subsequent projects.
II. BACKGROUND

Just as the Korean War entered its second year in June 1951, it was determined to examine Program X, the development of a new irradiated fuel separations facility, later called the Plutonium-Uranium Extraction (PUREX) Facility. The facility was needed to process 200 metric tons of irradiated, aluminum-clad uranium per month with the potential of increasing to 400 metric tons uranium per month. The PUREX Facility consists of a large concrete building 1,005 feet long, 104 feet high (with about 40 feet below grade), and 120 feet wide, with more than 50 smaller support buildings. Hot startup of the facility occurred in January 1956, just a little under three years from when construction started in April 1953.

In addition to processing aluminum clad fuel, the PUREX Facility was modified to process other types of fuel, including the N-Reactor zircaloy-clad fuel until PUREX was shut down in September 1972. The facility was prepared to restart in November 1983, and processed N-Reactor fuel intermittently until March 1990. The facility was shut down in a configuration that anticipated being restarted within a short period of time. Therefore, process solutions were left in various vessels and a significant volume of essential chemicals were left in storage. DOE directed the facility to be deactivated in December 1992. PUREX thus became the first large reprocessing facility with TSD units to be deactivated under the RCRA regulations.

III. DISCUSSION OF KEY PRINCIPLES

- If possible, identify that a facility will be deactivated before the final operation so product materials can be completely processed, systems flushed and wastes disposed of as part of the final operation. If not possible, as a minimum, consolidate wastes and dispose of them before they become dangerous waste in storage, requiring additional permitting.

The main activities involved in facility deactivation include:

- Remove/stabilize the hazards from the facility; particularly the fuel, special nuclear materials, chemical solutions and wastes;
- Place the facility in a stable condition; remove or stabilize the radionuclides;
- Shut down the utilities; consolidate and shut down the HVAC systems; eliminate the liquid effluents and deactivate the systems; and housekeep; and
- Disposition property and collect and archive records.

The materials at PUREX when DOE directed the facility to be deactivated included:

- ~ 6,000 gallons plutonium/uranium solution
- ~ 186,000 gallons 11M radioactive nitric acid
- ~ 200,000 gallons of water/dilute nitric acid
- ~ 21,000 gallons of radioactive TBP/NPH organic
- ~ 2,270,000 pounds of essential materials
- ~ 3.4 metric tons fuel (2.9 MT aluminum-clad fuel and 0.5 MT zircaloy-clad fuel)

A two-day session was held to brief the regulators and DOE about the hazards remaining in the facility and to solicit their involvement in determining the path forward. It became apparent that it was imperative that innovative ideas for handling the materials be developed to minimize waste and move deactivation along so the project could be completed.

- Involve the regulators early by: 1) helping them understand the capabilities and limitations of the facility; 2) developing an open and honest relationship with them; 3) showing the benefits of deactivation activities that are in everybody's interest to achieve; and 4) involving them in the decision making.

According to the RCRA regulations, material becomes waste 90 days after identified and has to be removed 90 days after that or the storage unit becomes a waste storage unit. Follow-on discussions with the regulators had to be held to reach agreement about what would be done with respect to the waste that was being stored in unpermitted vessels and the regulations requiring TSD units to be closed within 180 days after receiving the final waste shipment. It was clear that either removal of the waste solutions nor closure could not be done within the prescribed time period and it was in the interest of all involved to not spend resources at that time to close the permitted units. Closure would involve decommissioning which could not occur for many years and would require major resources; the Hanford land use plan had to be developed and agreed upon by all interested groups and an EIS had to be prepared to support the decommissioning; and, a deactivated facility was of little risk to human health or the environment.
especially in comparison to underground highly radioactive waste storage tanks located adjacent to the facility. Therefore, the decision was made to deactivate versus decommission the facility.

Discussions occurred between the Washington State of Ecology (Ecology), EPA, DOE and the contractor to determine what would be done during deactivation to reduce risks and meet the intent of the regulations while being cost effective. Specifics agreed to included: how dangerous waste vessels would be flushed; what samples would be taken; which laboratory analyses would be performed; what requirements would be applied to taking, handling and analyzing the samples, including QA requirements. The agreement was documented and signed by the various parties. Further understandings about how the deactivation was to be performed were agreed to when the End Point Specifications Document was approved.

AdditionAl meetings were held between Ecology, EPA and DOE to agree upon the overall direction for facility deactivation (see the following key principle), to develop performance milestones to ensure the deactivation activities for PUREX were progressing, and to formalize these in the Hanford Federal Facility Agreement and Consent Order (Tri-Party Agreement or TPA). The agreement resulted in eight milestones and nine target dates against which the PUREX deactivation project could be tracked.

Develop and agree with the regulators and the stakeholders on a process to be used for handling a facility through disposition.

The process for deactivating a complex facility in phases was developed and documented in the TPA. The process identified what should be done; who (including which regulatory groups) should be involved in the various steps and what documentation would be required through the deactivation, surveillance and maintenance, and facility disposition phases. While developing the process with the regulators, it was essential to define terms and what each meant since it was clear at the beginning of the discussions that the same term was used to mean different things. It was determined that the three major phases for facilities would be: 1) transition (deactivation); 2) surveillance and maintenance (S&M); and 3) disposition. Processes conducted during each of these phases would include: 1) facility stabilization, decontamination, deactivation, S&M during deactivation; 2) S&M with deactivation and decontamination on a case-by-case basis to further reduce facility S&M expenses; 3) decontamination, decommissioning, dismantlement, entombment, closure (as defined in the RCRA regulations) and site restoration during the disposition phase.

Defining the process in the TPA allowed stakeholders to review and comment on the process, thus including their values and comments. The portion of the flow sheet defining the transition process through deactivation is shown in Figure 1.

Devote sufficient time and effort to developing end points so that objectives of the different stakeholders are addressed, the proper level of resources are used in deactivation, and it is clear when the deactivation effort is complete and the facility is ready to enter the low cost, low risk S&M phase.

The end point method for several DOE facilities follows the EM-60 guidance. These methods of defining end points for facility stabilization and deactivation have been proven at PUREX and B Plant to be extremely effective in planning work and interacting with the regulators and environmental restoration contractors responsible for post stabilization S&M.

The end point method is a logical process of determining final conditions for each system and space. The final conditions of a facility are based on stated objectives, likely task types, and expected future uses for the systems and spaces.

The overall objective of deactivation is to achieve a safe, stable and environmentally sound condition, stable for an extended period, as quickly and economically as possible and to minimize the cost of the follow-on S&M phase. Once deactivated, the stable condition is maintained by means of a methodical S&M program, pending ultimate disposition which may not occur for tens of years. Therefore, the end points are driven by project objectives including:

- Protect Public & Environment
- Facilitate S&M - Protect Workers - Reduce Cost
- Facilitate Decommissioning
- Comply with Regulations & Requirements.
FIGURE 1. DEACTIVATION PHASE FLOWSHEET

- Facility lacks Future Mission
- Final Cleanout Runs Initiated
- Formal Shutdown Notice Issued by DOE-HQ
- Transition Planning
- Develop Project Management Plan
- Prepare and Submit Procurement Work Plan
- Review/Revize Project Management Plan
- Develop and Implement Plans and Procedures to Accomplish End-Point Criteria
- Submit End-Point Criteria Document
- Submit Surveillance and Maintenance Plan
- TPA Negotiations

Legend:
- Regulatory Involvement
- Regulatory Approval
- Tri-Party Agreement
- Negotiations
- DOD Work Products and Actions
- Regulatory Involvement and Approval in Part

To Surveillance Maintenance Phase
Several guiding principles form the foundation of the end point process:

♦ The decision to create an end point should be driven by, and clearly linked to, top-tier program objectives, not by feasibility or capability.

♦ The end point condition should employ a fundamental safety approach. This involves three layers of protection: elimination of hazards, effective facility containment, and facility monitoring and control.

♦ End point decisions are integrally linked to decisions (and constraints) on resources and methods. Cost effectiveness is important.

♦ A successful end point development requires ownership by all affected organizations including project planners, those who implement the plans, and the ultimate customers.

♦ Work teams in the field need clear, quantitative end points. They cannot work effectively with vague or functional objectives.

♦ It is not known when or what the ultimate facility disposition will be. Therefore, end point decisions should not be driven by dispositioning presumptions.

♦ End point development is an iterative process. Some end point decisions may have to be revisited as the stabilization proceeds.

As facility personnel complete end points, both the owner and the receiver sign that the end point has been completed. The process continues until all end points have been signed indicating completion of deactivation.

♦ Let people working at the facility know about the forthcoming challenges and encourage innovative ideas.

The traditional method for disposal of waste from the PUREX Facility was to adjust the pH to greater than 12 and add sodium nitrite to minimize corrosion of the transfer lines and the underground waste storage tanks. However, this process would turn the ~186,0000 gallons of 11M radioactive nitric acid into approximately 270,000 gallons of waste with over 5.4 million moles of sodium. Since sodium limits the ability to minimize waste that has to be vitrified and the intent is to vitrify the waste for future handling and storage, it was not desirable to add that much sodium.

The idea was presented to denitrate the nitric acid waste using sugar (Figure 2). This was a permitted treatment conducted as part of the waste treatment during PUREX operations. Sugar denitrating the nitric acid would result in less than 178,000 gallons of waste and less than 0.9 million moles of sodium that would have to be sent to the underground waste storage tanks. However, about 240 metric tons of NOx would be discharged to the atmosphere from the stack. The regulators were concerned about this and reluctant to agree to it.

Sometime later, another idea was proposed to send the nitric acid to another chemical reprocessing facility (Figure 2). After some research, it was determined that the nitric acid could be sent to the Sellafield, England, facility where it could be used as a product instead of disposed as a waste. The acid was shipped, allowing the schedule end date to be moved forward, saving considerable money, avoiding future cost or liability in having to deal with waste, and minimizing waste by reusing the nitric acid versus introducing fresh acid.

As facility personnel complete end points, both the owner and the receiver sign that the end point has been completed. The process continues until all end points have been signed indicating completion of deactivation.

♦ Involve the regulators as the direction of the deactivation plans change and clearly identify the benefits of the change.

Eight vessels were permitted as TSD units during normal operation. The facility was shut down in a state ready to resume operations when DOE issued the deactivation notice. The vessels which contained process solutions 180 days after the deactivation notice were determined to be dangerous waste storage vessels; thus an additional 37 vessels had to be added to the Part A Permit Application. Since there was no intent to close the dangerous waste units as identified in the regulations, the actions to deactivate each of these dangerous waste vessels had to be agreed to by Ecology.
and EPA. In a series of meetings between DOE and Ecology, it was determined that each vessel had to be flushed so the remaining heel (top empty vessels) did not designate as dangerous waste; the sample had to be taken and analyzed according to RCRA protocol; and the sample had to be analyzed for a specified list of constituents.

An innovative recommendation was proposed and the regulators agreed to flush the vessels in groups or loops and take a sample of the flush solution in the final vessel according to the criteria. The solution in the final vessel would be representative of the remaining heels in all the vessels. For this to work, the heels in the vessels before the flush all had to have a pH less than 7 and the heels had to be small in relation to the flush volume. For the permitted waste vessels, this recommendation decreased the number of flushes required, minimized waste by moving the same flush solution from one vessel to another, required only 15 samples instead of 45, reduced the resources required and cut costs. In addition, non-waste (process) vessels where included in the flush loops in order to eliminate the need for additional flushes and sampling those vessels. This process resulted in further waste minimization and cost savings.

Another innovative recommendation was to use a concentrator to boil off the flush water at a low rate and discharge the vapor out the stack with the air flow -- essentially humidifying the air flow. Therefore, it would not be necessary to add caustic and sodium nitrite to the flush solution before sending it to underground waste storage tanks. The evaporator used could evaporate the water and discharge it out the stack without reducing the quality of the gaseous discharge. This process was more cost effective than if the central onsite evaporator had been used.

♦ Use experienced people and lessons learned from other facilities to be more cost effective in conducting subsequent projects.

A small team of key people involved in the planning and execution of deactivation was established as another innovative idea to cost effectively deactivate facilities. The team consisted of people who developed the program, coordinated the technical planning, negotiated the regulatory strategy and milestones, generated the end points, organized effective teams to accomplish the deactivation work, planned the work, lead the field deactivation teams and coordinated close out of the end points. The intent is for the team to train people at other sites, provide guidance in setting up and conducting deactivation and decommissioning projects or "jump starting" deactivation projects to get them on the fast track.

ACKNOWLEDGMENTS

This work was conducted by Westinghouse Hanford Company and B&W Hanford Company under a contract with the United States Department of Energy.

REFERENCES
