0072979

HNF-33211
Revision 0
EDC #: HNF-EDC-07-33390

Hanford Site Sodium Disposition Evaluation Report

Document Type: RPT

T. M. Burke
Fluor Hanford, Inc.

RECEIVED
MAY 31 2007
EDMC

Date Published
May 2007

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

FLUOR®
P.O. Box 1000
Richland, Washington

MAY 03 2007
DATE:
STA:
HANFORD RELEASE
ID:
27
#22

Bonnie Wallace 5/3/07
Release Approval Date

Release Stamp

Approved for Public Release;
Further Dissemination Unlimited

TS-4-1

TRADEMARK DISCLAIMER

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.

This report has been reproduced from the best available copy.

Printed in the United States of America

Total Pages: 14

ACKNOWLEDGEMENT

Many people contributed to the preparation of this report. This includes Mr. Doug Chapin (U.S. Department of Energy, Richland Operations Office) who provided the ground work for the content and format of the report, and other individuals who provided valuable review and comment during preparation of the final report including:

- Rod Almquist, U.S. Department of Energy, Richland Operations Office
- Jeff Ayres, Washington State Department of Ecology
- Rick Bond, Washington State Department of Ecology
- Al Farabee, U.S. Department of Energy, Richland Operations Office
- Kent Hodgson, Fluor Government Group
- Rob Piippo, Fluor Hanford Incorporated
- Dave Polzin, Fluor Hanford Incorporated
- Mary Ryan, U.S. Department of Energy, Office of River Protection
- Mike York, Fluor Hanford Incorporated

EXECUTIVE SUMMARY

This Hanford Site Sodium Disposition Evaluation Report documents current planning by the Tri-Party Agreement Agencies, i.e., the U.S. Department of Energy (DOE), Richland Operations Office, the Washington State Department of Ecology, and the U.S. Environmental Protection Agency, for the management and disposition of the bulk radioactively contaminated sodium currently stored at the DOE Hanford Site. The sodium consists of a total of approximately 284,000 gallons stored in the 400 Area (Fast Flux Test Facility) and the 200 West Area (Hallam and Sodium Reactor Experiment). Issuance of this report satisfies the requirements of two Hanford Federal Facility Agreement and Consent Order (Tri-Party Agreement) Milestones (Milestones M-81-10-T01 and M-92-10) both of which have a due date of July 31, 2007.

Based on current planning, the conclusions documented in this report are:

- The sodium will be converted to 19 molar (50wt%) sodium hydroxide solution and used by the DOE, Office of River Protection (ORP), most likely in the pretreatment of radioactive waste prior to processing in the Waste Treatment Plant or possibly for chemistry control in the high level radioactive waste storage tanks.

- The schedule for conversion of the sodium to sodium hydroxide should be planned to coincide with the ORP need date for the sodium hydroxide because storage of sodium is safer and more efficient and requires less volume than storage of sodium hydroxide.

- The conversion of the sodium to sodium hydroxide will not utilize the Sodium Process Facility located at the Idaho National Laboratory. It is anticipated that a new conversion facility will be constructed adjacent to the Sodium Storage Facility located in the Hanford 400 Area.

Although intended to facilitate the aforementioned planning, this report does not preclude or predetermine sodium management decisions to be reached in the DOE National Environmental Policy Act Tank Closure and Waste Management Environmental Impact Statement Record of Decision.

TABLE OF CONTENTS

1.0 INTRODUCTION

In May and June 2005, the U.S. Department of Energy (DOE), Richland Operations Office (RL), the Washington State Department of Ecology (Ecology), and the U.S. Environmental Protection Agency (EPA), negotiated change packages under the Hanford Federal Facility Agreement and Consent Order (Tri-Party Agreement) extending the due dates to July 31, 2007, for the following milestones (Ecology, et al., Tri-Party Agreement Change Numbers M-81-05-01 and M-92-05-01, May 11, 2005; Letter, 05-AMRC-0366, "Contract No. DE-AC06-96RL13200 - Implementation of Tri-Party Agreement Milestones M-81-10-T01, Submit Final Sodium Disposition Evaluation Report, and M-92-10, Submit Hanford Site Sodium Disposition Evaluation Report to Ecology"):

- Target Tri-Party Agreement M-81-10-T01 milestone, *Submit Final Sodium Disposition Evaluation Report.*

- Interim Tri-Party Agreement M-92-10 milestone, *Submit Hanford Site Sodium Disposition Evaluation Report to Ecology.*

Historical planning and references for the management and disposition of the Hanford Site sodium inventory are well documented and can be reviewed in WHC-SD-FF-MP-001, *Hanford Site Sodium Management Plan*; Letter, 98-SPO-133, "Management Status of Hanford Site Sodium and NaK for the DOE Office of Inspector General Audit of Excess Non-Nuclear Materials and Chemicals"; and F0000-0079-ES-00, *Hanford Site Sodium Disposition Trade-Off Study*. This Hanford Site Sodium Disposition Evaluation (HSSDE) Report updates previous planning and has been prepared to satisfy both of the aforementioned milestones. Accordingly, this HSSDE Report contains:

- Identification of the current DOE Hanford Site inventory and storage locations of bulk radioactively contaminated metallic sodium to be dispositioned;

- The plan for converting/treating the sodium inventory to sodium hydroxide (caustic) solution for product reuse at Hanford by the DOE, Office of River Protection (ORP);

- Proposed timeframes for the Fast Flux Test Facility (FFTF) Project's conversion of the sodium to caustic and ORP's proposed need dates for receipt of the caustic; and

- A brief examination of regulatory compliance issues.

The RL Assistant Manager for River Corridor (AMRC), FFTF Project is responsible for meeting the M-81-10-T01 and M-92-10 Milestones.

This HSSDE Report is intended to facilitate planning among the Tri-Party Agreement Agencies (i.e., Ecology, EPA, and RL), but not preclude or predetermine decisions to be reached in the Tank Closure & Waste Management (TC&WM) Environmental Impact Statement (EIS) Record of Decision (ROD) through the National Environmental Policy Act (NEPA) process.

2.0 HANFORD SITE SODIUM INVENTORY

Currently, the total Hanford Site bulk radioactively contaminated metallic sodium inventory to be dispositioned is estimated to be 284,000 gallons. Table 1 summarizes the current categories, estimated quantities, and status/state and storage locations of the inventory (WHC-SD-FF-MP-001 and F0000-0079-ES-00).

Table 1. Hanford Site Radioactive Sodium Inventory

Sodium Category/Source	Estimated Quantity (gallons)	Status/State and Storage Location
FFTF	243,000 (see Note 1 below)	Stored in solid form under inert (argon or nitrogen) cover gas in three 80,000 gallon and one 52,000 gallon steel tanks located inside the Hanford Site's 400 Area Sodium Storage Facility
Hallam Reactor	34,000	Stored in solid form under inert (nitrogen) cover gas in five, 16,000 gallon stainless steel tanks inside the Hanford Site 200 West Area's 2727-W facility, a Butler-type steel building
Sodium Reactor Experiment (SRE)	7,000	Stored in solid form in 158 55 gallon drums sealed within 85 gallon overpacks inside eight storage modules in the Hanford Site 200 Area Central Waste Complex
Total	**284,000**	

Note 1: Previous documentation used a value of 260,000 gallons as the estimated total FFTF sodium volume. This was a preliminary conservative estimate used for planning purposes based on an early review of the sodium system fill records. The 243,000 gallons is the current calculated volume of sodium in the Sodium Storage Facility (based on measured sodium levels) plus an estimate of the additional small volume that will be added by the planned draining of nine large valves. A detailed review of FFTF sodium fill and drain data is provided in FFTF-32943, *Fast Flux Test Facility Sodium Volume Reconciliation.*

2.1 Fast Flux Test Facility Sodium

The largest portion of the Hanford Site sodium inventory, ~243,000 gallons (~86 percent of ~284,000 gallons), is stored in the 400 Area Sodium Storage Facility, immediately adjacent to the southwest of the FFTF Reactor Containment Building. The sodium was used as coolant in the FFTF, a DOE-owned, formerly operating, 400-megawatt (thermal) liquid-metal (sodium) cooled fast neutron flux nuclear research and test reactor. The facility is located in the 400 Area of DOE's Hanford Site in southeastern Washington State. A detailed description of the FFTF complex can be found in HEDL-400, *A Summary Description of the Fast Flux Test Facility*;

DOE/EA-0993, *Environmental Assessment: Shutdown of the Fast Flux Test Facility, Hanford Site, Richland, Washington*; DOE/EIS-0310F, *Final Programmatic Environmental Impact Statement for the Accomplishing Expanded Civilian Nuclear Energy Research and Development and Isotope Production Missions in the United States, Including the Role of the Fast Flux Test Facility* (Volume 2, Appendix D); and FFTF-18346, *Technical Information Document for the Fast Flux Test Facility Closure Project Environmental Impact Statement*. Currently, the FFTF Project is completing deactivation (i.e., shutdown or transition) work activities to go to a low-cost, surveillance and maintenance condition, during Fiscal Year (FY) 2009 through FY 2015. The FFTF Project is also planning future work to complete the project to achieve a final end state by 2030 (Letter, FH-0601796A R1, "Request for Cost Estimate and Schedule for the Fast Flux Test Facility (FFTF) Project "Cold and Dark" Planning Case"; Letter, FH-0602549A R1, "Revised Fast Flux Test Facility (FFTF) Project Direction"; and Letter, 06-AMRC-0370, "Contract No. DE-AC06-96RL13200 - Revised Fast Flux Test Facility (FFTF) Project Direction). In order to complete deactivation, the FFTF sodium (~242,000 gallons) has been drained to the maximum extent practicable from the FFTF Reactor Vessel, three primary and three secondary heat transport system loops, the Interim Decay Storage Vessel, and Fuel Storage Facility (FFTF-32943). An additional small volume (~700 gallons) of sodium will be drained from nine large primary system valves during 2007 and added to the Sodium Storage Facility. It is also possible that additional sodium could be removed from the plant systems later (during decommissioning activities) and added to the Sodium Storage Facility.

2.2 Hallam Reactor Sodium

The Hallam Reactor sodium, ~34,000 gallons (~12 percent of ~284,000 gallons) has been stored in the five 16,000 gallon stainless steel tanks inside the 2727-W Building since 1968 (WHC-SD-FF-MP-001). The sodium was received at Hanford in 1967 from the Hallam Reactor, a DOE-owned, formerly operating 200-megawatt (thermal) liquid-metal (sodium) cooled, graphite-moderated nuclear reactor. The facility operated from 1962 to 1964 and was decommissioned and dismantled between 1967 and 1969 (F0000-0079-ES-00 and DOE, *Hallam, Nebraska, Decommissioned Reactor Site, Fact Sheet*). Note that the original Hallam sodium volume stored at Hanford was approximately 65,000 gallons but 31,000 gallons was subsequently used in the Fuel Storage Facility.

2.3 Sodium Reactor Experiment Sodium

In 1975, Hanford received from the SRE facility in Canoga, Park, California, the SRE sodium, ~7,000 gallons (~2 percent of ~284,000 gallons) in 158 55 gallon inerted and sealed drums (WHC-SD-FF-MP-001). The SRE facility was developed to demonstrate a sodium-cooled, graphite-moderated reactor for civilian use. The reactor reached full power in May 1958 and provided electricity to the Southern California Edison Company grid before it was shut down in 1967. In order to comply with Resource Conservation and Recovery Act (RCRA) and

Washington Administrative Code requirements the 158 drums were overpacked into 85 gallon drums and transferred for storage within eight self-contained alkali metal storage modules in February of 1995. These modules are located within the boundary of the Hanford Site's 200 West Area Central Waste Complex near 16th Street and Dayton Avenue.

3.0 SODIUM TREATMENT AND PRODUCT REUSE

Consistent with the Tri-Party Agreement M-81-10-T01 and M-92-10 milestones, the Hanford Site sodium inventory is to be stored as product until processed (i.e., converted/treated) to sodium hydroxide (caustic) solution for product reuse at Hanford by the ORP for their Waste Treatment Plant or possibly used as corrosion control at the Hanford Tank Farms. This product reuse of the sodium, once converted to sodium hydroxide, is included in ORP's Waste Treatment Plant contract requirements (DOE-ORP-WED, *FFTF "Slightly Contaminated" Sodium Hydroxide Disposition Paper*).

Based on original planning, two options for processing the sodium inventory were evaluated as summarized in Table 2 (F0000-0079-ES-00).

Table 2. Original Planning of Hanford Site Sodium Inventory Processing Options

Option	Description
1 – Hanford Option	Use a to-be-constructed Sodium Reaction Facility in the 400 Area to convert on-site the Hanford Site sodium inventory to a caustic solution (50wt% sodium hydroxide in water) for product reuse by ORP.
2- DOE Idaho Option	Transport the Hanford Site sodium inventory (in ~4,000 gallon tanks by truck) to the existing DOE Idaho Operations Office (DOE-ID) Sodium Process Facility for converting the sodium to a caustic solution (50wt% sodium hydroxide in water), and return the caustic product (by truck) to the Hanford Site for product reuse by ORP.

The approximate quantities of the Hanford Site sodium inventory to be processed and the resulting quantities of 50wt% caustic that would be produced from either treatment option are shown in Table 3 (F0000-0079-ES-00), revised for the updated FFTF sodium volume.

Table 3. Estimated Quantity of Sodium Hydroxide Produced from Hanford Sodium

Sodium Category	Estimated Sodium Volume	Estimated Caustic Solution (50%wt Sodium Hydroxide in Water) Volume Produced
FFTF	243,000 gallons (980 tons)	537,000 gallons (3,500 tons)
Hallam Reactor	34,000 gallons (140 tons)	76,000 gallons (500 tons)
SRE	7,000 gallons (30 tons)	16,000 gallons (100 tons)
Total	**284,000 gallons (1,150 tons)**	**629,000 gallons (4,100 tons)**

Details of the feasibility of the treatment options, along with discussion of their operations, processes, costs, schedule, and regulatory issues were examined in detail in F0000-0079-ES-00. However, on April 21, 2006, RL sent a memorandum (Letter, 06-AMRC-0211, "Use of the Idaho National Laboratory (INL) Materials and Fuels Complex Sodium Processing Facility (SPF) for the Hanford Site Sodium") to the DOE-ID that based on current planning, the Sodium Process Facility would not be needed to process the Hanford Site sodium inventory in the foreseeable future. This is based on the recent FFTF Project planning of future work to place FFTF in a long-term surveillance and maintenance mode in accordance with reduced funding, during FY 2009 through FY 2015, and complete the project to achieve a final end state by 2030 (Letters, FH-0601796A R1, FH-0602549A R1, and 06-AMRC-0370). The sodium would remain stored for the foreseeable future at the Sodium Storage Facility (FFTF) and the Hanford Site 200 West Area (Hallam and SRE). In light of this information, RL is planning to fund, design, and build an operational Sodium Reaction Facility in the 400 Area during FY 2015 through FY 2020. This planning activity also supports meeting ORP's latest planned need date for product reuse of the caustic no sooner than FY 2018 (DOE-ORP-WED). Current ORP planning estimates the length of time for continuous Waste Treatment Plant utilization of the sodium hydroxide, converted from FFTF, Hallam and SRE sodium, during operations as two and a half to three years (DOE-ORP-WED).

Options, capacities, and timing for production, storage, and product reuse of the caustic at Hanford were evaluated in FFTF-28164, *Sodium Hydroxide Production and Storage for Hanford Bulk Sodium Disposition*. In this paper, six cost estimates were evaluated for providing caustic storage, which included modifying or relocating and modifying existing U-Plant tanks, and construction of new double wall or single wall tanks. The study concluded that the reuse of existing tanks in place has significant technical/schedule issues. Moving and refurbishing existing tanks has a small cost advantage over constructing and housing new single walled tanks, but technical concerns/risks remain. However, present planning by ORP indicates that they are not designing a tank or area to hold or store the caustic; rather, they are currently designing an exterior flanged pipe-connection on the north side of the Waste Treatment Plant's Pretreatment Facility and to the East of the Wet Chemical Facility. This connection will be utilized to route the caustic from a delivery-truck directly into the Waste Treatment Plant's vitrification (pretreatment) system during operation (DOE-ORP-WED). Furthermore, storage of sodium is judged to be both safer and more efficient than storing sodium hydroxide. This is because the volume of the hydroxide is more than twice the corresponding volume of sodium and the hydroxide will generally be in liquid form during storage. The hydroxide is also a strong caustic, potentially leading to corrosion of the storage tanks. On the other hand, the sodium would be stored in solid form and is not corrosive to steel. Both sodium and sodium hydroxide storage would require maintenance of an inert gas (e.g., nitrogen) blanket. The sodium storage capability already exists while the hydroxide storage capability does not. Some limited caustic storage capacity is likely to be included as part of the Sodium Reaction Facility.

4.0 REGULATORY ISSUES

During the previous planning, regulatory compliance with RCRA, NEPA, the Tri-Party Agreement (Hanford only), and the Clean Air Act were analyzed in detail (F0000-0079-ES-00). Note that an additional Environmental Assessment was prepared in 2006 (DOE/EA-1547F, *Environmental Assessment, Sodium Residuals Reaction/Removal and Other Deactivation Work Activities, Fast Flux Test Facility (FFTF) Project, Hanford Site, Richland, Washington*) but this covered the future planned disposition of sodium residuals in the FFTF, not the bulk sodium.

On February 2, 2006, DOE announced its Notice of Intent (NOI) (71 FR 5655, "Notice of Intent to Prepare the Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, WA") to prepare, under NEPA, a TC&WM EIS for the Hanford Site (TC&WM EIS, in progress), to which Ecology is a Cooperating Agency. In this NOI, DOE decided to merge the scope of the NEPA FFTF EIS (69 FR 50176, "Notice of Intent to Prepare an Environmental Impact Statement for the Decommissioning of the Fast Flux Test Facility at the Hanford Site, Richland, WA") and the TC&WM EIS (71 FR 5655) to further coordinate resources and ensure a comprehensive look at environmental impacts at Hanford.

In the TC&WM EIS, the potential environmental impacts of DOE's proposed final FFTF decontamination and decommissioning end state alternatives (i.e., No Action, Entombment, and Removal) are currently being evaluated. Although current planning does not anticipate RL use of the Idaho National Laboratory Sodium Process Facility for processing the Hanford Site bulk radioactively contaminated sodium, the option has been retained for analysis in the TC&WM EIS as a reasonably foreseeable alternative from a NEPA perspective, along with analysis of the option of converting the sodium inventory on the Hanford Site (i.e., 400 Area) (Letter 06-AMRC-0211 and DOE-ORP-WED). DOE's decisions regarding the above are planned for inclusion in the TC&WM EIS ROD, currently scheduled for issuance in early 2009. This HSSDE Report is intended to facilitate current Hanford Site sodium management planning by the Tri-Party Agreement agencies (i.e., RL, Ecology and EPA) but not preclude or predetermine decisions to be reached in the TC&WM EIS ROD through the NEPA process.

5.0 REFERENCES

05-AMRC-0366, 2005, "Contract No. DE-AC06-96RL13200 – Implementation of Tri-Party Agreement Milestones M-81-10-T01, Submit Final Sodium Disposition Evaluation Report and M-92-10, Submit Hanford Site Sodium Disposition Evaluation Report to Ecology," (external letter 05-AMRC-0366 to R.G. Gallagher, Fluor Hanford, Inc., from K.A. Klein, U.S. Department of Energy, Richland Operations Office, Richland, Washington), July 19.

06-AMRC-0211, 2006, "Use of the Idaho National Laboratory (INL) Materials and Fuels Complex Sodium Processing Facility (SPF) for the Hanford Site Sodium," (external letter 06-AMRC-0211, to E.D. Sellers, U.S. Department of Energy, Idaho Operations Office, from K.A. Klein, U.S. Department of Energy, Richland Operations Office, Richland, Washington), April 21.

06-AMRC-0370, 2006, "Contract No. DE-AC06-96RL13200 – Revised Fast Flux Test Facility (FFTF) Project Direction," (external letter to R.G. Gallagher, Fluor Hanford, Inc., from K.A. Klein, U.S. Department of Energy, Richland Operations Office, Richland, Washington), September 29,

69 FR 50176, 2004, "Notice of Intent to Prepare an Environmental Impact Statement for the Decommissioning of the Fast Flux Test Facility at the Hanford Site, Richland, WA," *Federal Register* (August 13).

71 FR 5655, 2006, "Notice of Intent to Prepare the Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, WA," *Federal Register* (February 2).

98-SPO-133, 1998, "Management Status of Hanford Site Sodium and NaK for the DOE Office of Inspector General Audit of Excess Non-Nuclear Materials and Chemicals," (external letter 98-SPO-133 to M.J. Pollock, DOE Office of Inspector General, from O.A. Farabee, FFTF SPO, September 17,

DOE, August 20, 2006, *Hallam, Nebraska, Decommissioned Reactor Site, Fact Sheet*, U.S. Department of Energy, Office of Legacy Management.

DOE/EA-0993, May 1995, *Environmental Assessment: Shutdown of the Fast Flux Test Facility, Hanford Site, Richland, Washington*, U.S. Department of Energy, Washington, D.C.

DOE/EA-1547F, March 2006, *Environmental Assessment, Sodium Residuals Reaction/Removal and Other Deactivation Work Activities, Fast Flux Test Facility (FFTF) Project, Hanford Site, Richland, Washington*, U.S. Department of Energy, Richland, Operations Office.

DOE/EIS-0310F, December 2000, *Final Programmatic Environmental Impact Statement for Accomplishing Expanded Civilian Nuclear Energy Research and Development and Isotope Production Missions in the United States, Including the Role of the Fast Flux Test Facility*, U.S. Department of Energy, Washington, D.C.

DOE-ORP-WED, January 26, 2007, *FFTF "Slightly Contaminated" Sodium Hydroxide Disposition Paper*, Rev. 01, U.S. Department of Energy, Office of River Protection.

F0000-0079-ES-00, *Hanford Site Sodium Disposition Trade-Off Study*, April 2002, Argonne National Laboratory, Idaho Falls, Idaho, and Fluor Hanford Inc., Richland, Washington.

FFTF-18346, May 2005, *Technical Information Document for the Fast Flux Test Facility Closure Project Environmental Impact Statement*, Revision 1A, Fluor Hanford Inc., Richland, Washington.

FFTF-28164, December 29, 2005, *Sodium Hydroxide Production and Storage for Hanford Bulk Sodium Disposition*, Rev. 0, Fluor Hanford Inc., Richland, Washington.

FFTF-32943, March 2007, *Fast Flux Test Facility Sodium Volume Reconciliation*, Rev. 0, Fluor Hanford Inc., Richland, Washington.

FH-0601796A R1, 2006, "Request for Cost Estimate and Schedule for the Fast Flux Test Facility (FFTF) Project "Cold and Dark" Planning Case," from R.G. Gallagher (internal letter FH-0601796A R1 to K.A. Klein), Fluor Hanford Inc., Richland, Washington, August 18.

FH-0602549A R1, 2006, "Revised Fast Flux Test Facility (FFTF) Project Direction," from R.G. Gallagher (internal letter FH-0602549A R1 to K.A. Klein), Fluor Hanford Inc., Richland, Washington, November 15.

HEDL-400 Report, October 1980, *A Summary Description of the Fast Flux Test Facility*, Westinghouse Hanford Company.

M-81-05-01, Ecology, EPA, and RL, Hanford Federal Facility Agreement and Consent Order Change Control Form (Change Number M-81-05-01), *Hanford Site Final Sodium Disposition Evaluation Report Target Date M-81-10-T01 Due Date Modification*, dated May 11, 2005, and approved by RL on May 13, 2005 and Ecology on June 6, 2005.

M-92-05-01, Ecology, EPA, and RL, Hanford Federal Facility Agreement and Consent Order Change Control Form (Change Number M-92-05-01), "*Hanford Site Sodium Disposition Interim Milestone M-92-10 Due Date Modification*," dated May 11, 2005, and approved by RL on May 13, 2005 and Ecology on May 31, 2005.

WHC-SD-FF-MP-001, September 26, 1995, *Hanford Site Sodium Management Plan*, Rev. 1, Westinghouse Hanford Company, Richland, Washington.