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		Date 9/30/94
Project Title/Work Order: PRELIMINARY SAFETY EVALUATION (PSE) FOR THE SODIUM STORAGE FACILITY AT FFTF		EDT No.
		ECN No. 608177

Name	MSIN	With Attach.	EDT/ECN & Comment	EDT/ECN Only
OSTI (2)	L8-07	X		
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A-6000-135 (12/87)

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SEP 30 1994 433cl 9/30/94
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ENGINEERING DATA TRANSMITTAL

1. EDT 608177

2. To: (Receiving Organization) FFTF Shutdown Project Office	3. From: (Originating Organization) FFTF Engineering	4. Related EDT No.: 602445
5. Proj./Prog./Dept./Div.: FFTF Shutdown/FFTF Eng.	6. Cog. Engr.: D. L. Polzin	7. Purchase Order No.:
8. Originator Remarks: For approval and release.		9. Equip./Component No.:
		10. System/Bldg./Facility: Sodium Storage Facility
11. Receiver Remarks:		12. Major Assm. Dwg. No.:
		13. Permit/Permit Application No.:
		14. Required Response Date: September 28, 1994

15. DATA TRANSMITTED

(A) Item No.	(B) Document/Drawing No.	(C) Sheet No.	(D) Rev. No.	(E) Title or Description of Data Transmitted	(F) Approval Designator	(G) Reason for Transmittal	(H) Originator Disposition	(I) Receiver Disposition
1	WHC-SD-FF-PSE-002		0	Preliminary Safety Evaluation for the Sodium Storage Facility	ESQ	1	1	

16. KEY

Approval Designator (F)	Reason for Transmittal (G)	Disposition (H) & (I)
E, S, Q, D or N/A (see WHC-CM-3-5, Sec.12.7)	1. Approval 2. Release 3. Information 4. Review 5. Post-Review 6. Dist. (Receipt Acknow. Required)	1. Approved 2. Approved w/comment 3. Disapproved w/comment 4. Reviewed no/comment 5. Reviewed w/comment 6. Receipt acknowledged

17. SIGNATURE/DISTRIBUTION (See Approval Designator for required signatures)

(G) Reason	(H) Disp.	(J) Name	(K) Signature	(L) Date	(M) MSIN	(J) Name	(K) Signature	(L) Date	(M) MSIN	(G) Reason	(H) Disp.
1	1	Cog.Eng. DL Polzin	[signature]	9/30/94	N2-56	BR Bowman	[signature]	9/28/94	N2-56	1	1
1	1	Cog. Mgr. CG McCargar	[signature]	9/29/94	N2-56	GB Griffin	[signature]	9/29/94	N2-34	1	1
1	1	QA JE Parker	[signature]	9/30/94	N1-71	JN Paglieri			N1-72	BA3	
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1	1	JC Van Keuren	[signature]	9/29/94	H4-64	WA Dautel			N2-53	BA3	

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BD-7400-172-2 (04/94) GEF097

BD-7400-172-1 (07/91)

RELEASE AUTHORIZATION

Document Number:	WHC-SD-FF-PSE-002, REV.0
Document Title:	Preliminary Safety Evaluation (PSE) for Sodium Storage Facility at the Fast Flux Test Facility
Release Date:	9/30/94

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A-6001-400 (07/94) WEF256

SUPPORTING DOCUMENT

1. Total Pages 28

2. Title

PRELIMINARY SAFETY EVALUATION FOR THE SODIUM STORAGE FACILITY

3. Number

WHC-SD-FF-PSE-002

4. Rev No.

0

5. Key Words

SODIUM STORAGE, SAFETY CLASSIFICATION SAFETY EVALUATION

APPROVED FOR PUBLIC RELEASE 9/30/94

6. Author

Name: B. R. BOWMAN

B R Bowman

Signature

Organization/Charge Code 18230/B1033

7. Abstract

SAFETY CLASSIFICATION FOR SODIUM STORAGE FACILITY SYSTEMS STRUCTURES AND COMPONENTS HAVE BEEN PERFORMED IN A PRELIMINARY SAFETY EVALUATION OF POTENTIAL ACCIDENTS

9. Impact Level ESQ

10. RELEASE STAMP

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PRELIMINARY SAFETY EVALUATION (PSE) FOR SODIUM STORAGE FACILITY AT THE FAST FLUX TEST FACILITY

1.0 INTRODUCTION AND SUMMARY

The Sodium Storage Facility (SSF) will be constructed at the Fast Flux Test Facility (FFTF) in the area adjacent to the South and West Dump Heat Exchanger (DHX) pits. The purpose of the facility is to allow unloading the sodium from the FFTF plant tanks and piping. Significant electrical energy consumption, equipment maintenance and surveillance manpower are presently required to maintain the sodium systems in a molten condition. The sodium will be transferred to the facility into three 80,000 gallon tanks and one 52,500 gallon tank that are ASME Section III vessels originally constructed for the Clinch River Breeder Reactor (CRBRP). When the tanks are full, the trace heat will be turned off and the sodium will be allowed to freeze. The sodium will be stored in this condition until it is melted and transferred to the Sodium Reaction Facility (SRF). The maximum time any one tank is expected to be molten is four months. An approximate 93 foot by 90 foot concrete building will house the tanks. To accommodate sodium leaks, the floor of the building will be lined with a drip pan that forms a sump with the capacity for one of the larger tank's contents. This sump will be covered by a deck plate system approximately 2 feet above the floor (theoretical height of the sodium of one tank's contents). The deck plate cover will have one inch diameter holes spaced under the piping and the smaller tank to allow sodium entry, but will restrict air flow back into the sump to suppress sodium burning. The cover will also have a two inch gap at the interface to the other three tanks to permit sodium flow into the sump while still restricting air flow. The air gaps and holes will be less than one percent of the total floor area, which was a design parameter used in the sodium fire testing conducted in support of FFTF construction.

The significant conclusion of this Preliminary Safety Evaluation (PSE) is that the only Safety Class 2 components are the four sodium storage tanks and their foundations. The building, because of its imminent risk to the tanks under an earthquake or high winds, will be Safety Class 3/2, which means the building has a Safety Class 3 function with the Safety Class 2 loads of seismic and wind factored into the design. This designation is consistent with the WHC-CM-4-46 Chapter 9 Waiver WA-537. All other structures and components are Safety Class 3 or 4 as shown in the preliminary Safety Equipment List (SEL), Appendix B.

The credible Design Basis Accident scenario is the leak of one tank's contents into the building with the majority of the sodium entering the covered sump. In the sump, the burning sodium will self-extinguish due to the exclusion of oxygen which is consumed by the combustion process (and not replaced through the limited hole area in the deck plates). Preliminary analyses of the burning of all the sodium (80,000 gal.) without taking credit for the covered sump indicate a potential moderate hazard (sodium hydroxide [NaOH]) at the site boundary and a high hazard (NaOH) for the on-site worker. However, the overall classification of the facility is moderate as stated in the Hazard Categorization and Classification for the SSF (Reference 1). Although the sodium has a radioactive inventory of sodium-22, cesium-137 and tritium, the radiation levels are so low that the entire 140,000 gallon inventory deposited at the site boundary, as in the Hazard Categorization calculations (Reference 1), indicates a less than Hazard Category 3 facility per DOE Standard 1027-92 . These radiation levels are acceptable even without accounting for the mitigation that would occur from a real accident scenario.

2.0 DESIGN CRITERIA

DOE Order 6430.1A, General Design Criteria, Section 1300, Special Facilities, requires identification of Safety Class items for further differentiating design criteria. Therefore, a safety classification must be determined for systems, structures and components (SSCs) of the SSF.

Safety classification for the SSCs for the SSF are established in the following paragraphs per the requirements of WHC-CM-4-46, Chapter 9, *Safety Classification of Systems, Structures and Components*, Rev. 0, dated August 26, 1994. The WHC Safety Department has approved waiver WA-537 to WHC-CM-4-46 Chapter 9 that downgrades environmental hazards from Safety Class 1 and defines the Safety Class 3/2 such that the lower classed SSC retains its Safety Class 3 functional designation with the attributes that will prevent interaction with the Safety Class 2 SSC requiring the higher level of design analysis and/or quality assurance. Table 1 of Chapter 9 presents the criteria for assigning safety classification to systems, structures and components.

- Radiological criteria for doses are 0.5 Rem EDE off-site for Safety Class 1 or 5 Rem EDE on-site for Safety Class 2. For the SSF, doses were reported in the FFTF Shutdown Environmental Assessment (Reference 2) as 2.5×10^{-4} and 3.9×10^{-4} Rem, respectively. These are much lower than the preceding criteria, indicating a Safety Class 3 or less. These dose calculations were done for the environmental assessment (EA) beyond design basis accident using 50% meteorology data. The doses would still be well below acceptance criteria using 99.5% meteorology data.

- Criteria for the airborne concentrations of non-radiological hazardous material are: off-site chemical concentrations exceeding ERPG-2 values require Safety Class 1 and on-site chemical concentrations exceeding ERPG-3 values require Safety Class 2. For sodium hydroxide (NaOH), the hazardous chemical form created by the burning of sodium, the ERPG-2 limit is 40 mg/m^3 and the ERPG-3 limit is 100 mg/m^3. Using the release calculations of the accident in Reference 1, the off-site and on-site concentrations of NaOH are 6.2 mg/m^3 and 46,750 mg/m^3, respectively. Therefore, the facility must contain Safety Class 2 SSC's depending on the accident scenarios developed in Section 4 of this PSE.

- The criteria in Waiver WA-537 to Chapter 9 of CM-4-46 for environmental hazard safety classification (EHSC) requires a Safety Class 2 assignment for calculated EHSC values exceeding 1,000,000. Appendix A contains the calculations for the EHSC for SSF. Since the value is in excess of 1,000,000, the safety classification is Safety Class 2.

The overall preliminary safety classification of the SSF SSCs is 2. Next, the extent of the SSCs within the SSF to be assigned Safety Class 2 designators must be determined. The two bounding accident scenarios as developed in Section 4 of this PSE have been assessed for use in determining SSC Safety Class designations.

Since building failure under earthquake or extreme wind conditions could cause tank failure, the building, roof and mezzanine will be designated Safety Class 3/2. Since the building, itself, clearly does not perform a Safety Class 2 function, but only provides Safety Class 3 functions of shielding and weather protection, the Safety Class 2 attributes of seismic and wind load will be incorporated in the design analysis .

The tank leakage (metal defect, crack propagation) leads to the tanks being classified as Safety Class 2, including their mounting and foundations. Safety Class 2 per DOE 6430.1A does not require application of the ASME Section III Code for piping and vessels and the ANSI/ASME B31.1 for the SSF system meets the requirements of Safety Class 2. The ASME Section III Class 2 and 3 nuclear-grade vessels in this B31.1 system exceeds the Safety Class 2 criteria. Trace heat, insulation and thermocouples are Safety Class 4. They do not require the 3/2 designation for additional seismic qualification since their masses could not damage the tank or change its seismic response.

Since the other credible accident scenarios in on-site consequences, and only in-plant hazards, the remainder of SSCs in the SSF can be assigned a Safety Class 3 or 4 designation.

Summarizing this safety classification, the tanks and their foundations are the only Safety Class 2 components. The building's foundations, walls, roofs and mezzanine are Safety Class 3/2 with the critical characteristic of Safety Class 2 seismic and wind loads, as applicable. All the remaining structures and components of the SSF are Safety Class 3 or 4. Appendix B contains the preliminary Safety Equipment List.

3.0 HAZARDOUS INVENTORIES

Radioactive Inventory

The primary heat transport system sodium contains radioactive sodium isotopes from neutron activation of the sodium and corrosion products during its passage through the reactor core. The sodium also contains some fission and activation products which have leaked from the fuel or the absorber assemblies. Samples of both primary and secondary sodium have been analyzed to determine the quantity of radioactive elements contained in the sodium. The Fuel Storage Facility (FSF) and Interim Decay Storage (IDS) sodium have not been directly exposed to the reactor neutron flux, but contain some radioactive elements from sodium transferred with the fuel assemblies that were in the reactor, or from the leakage of activation or fission products during storage of the fuel or absorber assemblies. The radionuclide concentrations in the FSF and IDS sodium are estimated to be much less than the primary sodium. Primary sodium radionuclide concentrations are conservatively assumed for this analysis for all the sodium except the secondary HTS sodium. The secondary HTS sodium contains no activation, corrosion or fission products, but some tritium has diffused into the system.

The most recent sodium analyses were made in February 1993. The SSF is scheduled for off-load of the FFTF sodium in late 1997. The inventory in March 1993 and its adjustment for 4 more years of decay to March 1997 are provided in Table 1. As stated in Reference 1, the radionuclide inventory places the facility in the "radiological" facility category.

Table 1 - Radionuclide Inventories in the SSF

Isotope	Specific Activity on 3/93 (Ci/gm)	Specific Activity on 3/97 (Ci/gm)	Total Activity on 3/97 (Ci)
Primary HTS, FSF and IDS Sodium (194,000 gallons - 6.7×10^8 gms)			
Na-22	5.2E-07	1.8E-07	120
Cs-137	1.0E-10	9.1E-11	0.06
Pu-239	1.2E-12	1.2E-12	0.0008
H-3	1.6E-07	1.3E-07	85
Secondary HS Sodium Inventory (66,000 gallons - 2.3×10^8 grams)			
H-3	6.4E-08	4.8E-08	11
Total Secondary + Primary HTS Sodium Tritium H-3			96

Hazardous Material Inventory

Sodium in the solid form is listed as a Hazardous Material in 40CFR302, but is not readily dispersed to the environment in this form. The actual Hazardous Material listed in 40CFR302 is the sodium hydroxide (NaOH) resulting from the burning of sodium in air and the subsequent combination with the moisture in the air. The quantity of sodium to be transferred from FFTF to the SSF is 260,000 gallons. However, only two tanks will be molten at one time. Conservatively for the two largest tanks full, this would be 160,000 gallons of sodium or 2.2×10^6 pounds of NaOH used in the Environmental Hazard Safety Classification worksheet in Appendix A.

4.0 ACCIDENT EVALUATION

A Preliminary Hazards Assessment table (Table 2) was developed to list: the hazards, accident scenarios leading to the hazard consequence, the severity of the consequence (off-site, on-site @ 100m, in-plant), the estimated probability and some of the mitigating features of the conceptual design. Appendix C utilizes data from References 3, 4, 5, 6, 7 and 8 to develop the probabilities listed in Table 2.

The bounding accident(s) are the ones with the greatest probability and the most severe consequences of release. The two to be addressed further are: (1) the earthquake (with a probability of occurring at the 400 Area of 2.5×10^{-4} per year) causing damage to the tank and (2) the crack due to metal defect and subsequent leak of the tank with a probability of 1×10^{-5}/year. In these tank leak or rupture accidents, the consequences are most severe because the sodium cannot be prevented from continuing to spill into the building sump.

- The combined probability of the earthquake occurring and the small probability that the walls, roof or mezzanine could fail in such a manner to create missiles that would drop on the one inch thick tank shell and cause a crack and subsequent leak is Unlikely. To minimize the probability of this event, the building and mezzanine will be qualified by design to the same seismic and wind load criteria as the tanks.

- Tank leakage due to thermal-transient-induced crack propagation is Extremely Unlikely for these tanks since they will experience only two thermal cycles with molten sodium. Reference 9 analyzes the Nil Ductility Transition Temperature (NDTT) for these tanks and concludes the small tank is +10°F and the three dump tanks are +30°F with assurance to be provided in the design analysis for this application that the stresses are low to prevent crack propagation. If the tank should leak into the sump, the sump and building can be credited for plateout and plume dissipation, since a simultaneous earthquake or high wind is incredible.

Table 2 indicates that the probability of the other identified accident scenarios is equivalent to the tank accidents, but the consequences are much less severe since the spill quantities from the piping are relatively small compared to the tank spills.

- The probability of an earthquake causing damage by either the building/mezzanine falling on the piping or by interaction with the piping supports is Unlikely. The worst case would be for the piping to fail at some low point below the tank such as in the pipeway since the leak there could cause the sodium to be siphoned out. The Conceptual Design Report (Reference 10) includes siphon break piping between the high point sodium piping and each tank's cover gas volume with a normally locked open valve. Sodium flowing from the high point to exit the piping at the low point crack/break would draw cover gas from the tank atmosphere rather than sodium from the tank and break the siphon. Only the small amount of sodium in the 2 inch line spills into the sump in the building or the drip pan in the pipeway. If the siphon piping fails (leaks) under seismic conditions, building air will break the siphon.

- Leakage from high point piping or valves would result in only the small portion of the sodium spilling into the building sump for suppression. These types of fires are not of the magnitude to be a threat to personnel outside the building, are within the capability of the building sump and cover to control, and are bounded by the larger spills of tank leaks.

- Failure of the piping at the top of the tank would permit air to enter the tank, but the small limited openings of the piping would suppress the fire in the tank by omitting air after the initial air is consumed.

Two other credible accidents are the break of transfer piping in the pipeway or Cell 431 above T-44 and the transfer piping from the Fuel Storage Facility (FSF) through the Reactor Service Building (RSB) to the existing transfer system. These accidents can only occur during the transfer of sodium through the lines. The valves at each end would be monitored by Operations personnel and would be closed at the first indication of a leak. The pipeway and Cell 431 are protected from the siphon of the large SSF tanks backward by the anti-siphon connection described previously. The piping from FSF runs through the RSB at a high point and the only sodium spilled would be that in the high point line.

TABLE 2

SODIUM STORAGE FACILITY HAZARDS TABULATION

HAZARD	ACCIDENT SCENARIO	SEVERITY [1]	PROBABILITY [2]	MITIGATORS
Sodium Fire	Tank **leak**			
	- metal defect	Cat II	10^{-5} Extremely Unlikely	Covered sump, building, insul.
" "	Tank **rupture**			
	- metal defect	Cat II	$<10^{-10}$ Incredible	Covered sump, building
	- overpressurize tank & relief valve failure	Cat II	3×10^{-8} Incredible	Covered sump, building
	- building or mezzanine collapse; seismic or wind	Cat II	2.5×10^{-4} Unlikely	Qualified structure
" "	2" fill/drain **leak** - **high** point			
	- piping metal defect	Cat III	10^{-5} Extremely Unlikely	Covered sump, building
	- metal defect valves	Cat III	3.5×10^{-4} Unlikely	Covered sump, building
" "	2" fill/drain **rupture** - **high** point			
	- metal defect	Cat III	$<10^{-10}$ Incredible	Covered sump, building
	- mezzanine or roof collapse; seismic or wind event	Cat III	2.5×10^{-4} Unlikely	Qualified structures

(1) Categories of Severity; from WHC-CM-4-46, Appendix B, i.e., Cat I, off-site; Cat II, on-site; Cat III, in-plant; Cat IV, industrial
(2) Probability values from Appendix C; Probability categories from WHC-CM-4-46, Appendix B

TABLE 2 (CONTINUED)

HAZARD	ACCIDENT SCENARIO	SEVERITY (1)	PROBABILITY (2)	MITIGATORS
Sodium Fire	2" fill/drain leak - low point			
	- metal defect	Cat III	10^{-5} Extremely Unlikely	Siphon break bldg., operator
" "	2" fill/drain rupture - low point			
	- metal defect	Cat III	$<10^{-10}$ Incredible	Covered sump, building
	- seismic interaction unqualified hangers	Cat III	2.5×10^{-4} Unlikely	Siphon break, operator
	- wall collapse; seismic or wind seismic bounds	Cat III	2.5×10^{-4} Unlikely	Qualified building
	- roof collapse; seismic or wind seismic bounds	Cat III	2.5×10^{-4} Unlikely	Qualified building
" "	Cover gas piping failure -air/fire in tank - seismic bounds	Cat III	2.5×10^{-4} Unlikely	Tank
" "	Transfer piping leak/break in pipeway/431 - seismic bounds	Cat III	2.5×10^{-4} Unlikely	Operator
" "	Transfer piping leak/break in FSF, RSB - seismic bounds	Cat III	2.5×10^{-4} Unlikely	Operator
Sodium Aerosol	Cover gas release in building seismic bounds	Cat III	2.5×10^{-4} Unlikely	No aerosol at 400°F
Inert Gas	Oxygen depletion	Cat IV		Installed O_2 Monitors
Electrical	Fire, shock	Cat IV		Administrative, Eletrical Code

5.0 CONSTRUCTION RISKS

Construction of the SSF does not create a risk to the existing FFTF buildings.

6.0 SAFETY DOCUMENTATION

The safety analyses for the SSF will be performed in accordance with the DOE Order 5481.1B for a non-nuclear facility and documented in a separate Safety Analysis Report (SAR) during the detailed design phase. Keeping this documentation separate from the FFTF FSAR is desirable since the SSF may be operational longer than the FFTF systems.

The installation and operation of the sodium transfer lines from the plant to the SSF building and from FSF to the plant piping will be discussed and analyzed in changes to the FFTF FSAR.

7.0 PROJECT INTERFACES

The SSF will interface with the FFTF plant as follows:

- A 2 in. diameter sodium transfer pipe will be extended from the connecting point in Cell 401 just above T-44 sodium storage tank and pass through Cell 431, an unlined cell just above 401, and then through the pipeway (with drip pan) that was intended for future expansion of Closed Loops 3 & 4, which runs west then south into the SSF.

- A 1 in. diameter pipe for argon/nitrogen supply from the plant will connect to the existing argon header at the reducer station in Cell 431 then run through the CL 3&4 pipeway to the SSF. Initially argon will be supplied, but will be eventually converted to nitrogen when the plant argon system is converted to nitrogen.

- Electrical power will be supplied from the 13.8 Kv system in manhole #4 adjacent to the southwest corner of SSF and be reduced in voltage for use in the facility by a transformer provided by the project.

- Fire alarm signals from the SSF system will be radio transmitted to the Central Fire Station and via conduit in the pipeway to the plant system for alarm relay to the FFTF Control Room.

- Oxygen monitor alarms in the SSF will be relayed via conduit to the FFTF Control Room.

- Conduits from the plant will also route Public Access Exchange telephone line and Public Address speaker lines to the SSF. The one system will provide communications between SSF and the plant during the sodium transfer evolutions. The other system will provide site emergency alarms to the facility as well as other general announcements.

The interfaces with the Sodium Reaction Facility (SRF), which is planned for design several years in the future, are not determined at this time. However, it is anticipated that it will be in the general vicinity of the SSF and is therefore shown on the CDR plot plans. A connection is also provided on the sodium transfer piping for future routing to the SRF.

8.0 ITEMS REQUIRING FURTHER RESOLUTION

The stress analyses for the dump tanks will have to be reanalyzed to show that the thermal transient of heat-up from ambient to thaw the sodium will create stresses that are less than 20% of allowable. This will resolve the NDTT issue of crack propagation since the tank's forging was not volumetrically examined for internal cracks.

Table 2.1 of CM-4-46 indicates that a preliminary Fire Hazards Analysis (FHA) should be prepared along with the PSE and the CDR. The requirement for submittal of an FHA in both DOE 6430.1A and in CM-4-41 is with Title I design and the PSAR. The hazards table developed in Section 4 shall suffice for the preliminary FHA at this time. Many other fire protection issues have been evaluated and incorporated in the CDR. An exemption request was submitted to DOE-RL for concurrence by the Washington State Department of Ecology for two differences with the Uniform Fire Code, which is invoked by the WAC 173-303 for hazardous waste storage. The issue of Maximum Possible Fire Loss including cleanup costs has not been included. The Fire Hazards Analysis will be incorporated into the Safety Analysis Report for the SSF.

9.0 REFERENCES

1. WHC-SD-FF-HC-002, Hazard Categorization and Classification of the Sodium Storage Facility, August 30, 1994

2. Letter, J. C. Midgett (WHC) to J. E. Mecca (DOE-RL), "Environmental Assessment: Shutdown of the Fast Flux Test Facility, Hanford Site, Richland, Washington", 9452321.1, dated July 29, 1994

3. SDC-4.1, Standard Architectural-Civil Design Criteria, Design Loads for Facilities, Rev. 12

4. WHC-SD-GN-DB-003, Natural Phenomena Hazards: The Hanford Site, Richland, Washington, August 1, 1989

5. UCRL-15910, Design and Evaluation Guidelines for Department of Energy Facilities Subjected to Natural Phenomena Hazards, R.P. Kennedy, et al, June, 1990

6. EGG-SS-RE-8875, Informal Report, Generic Component Failure Data Base for Light Water and Liquid Sodium Reactors Probabilistic Risk Assessments, S.A. Eide, February, 1990

7. CRBRP-4, Clinch River Breeder Reactor Plant Probabilistic Risk Assessment, Technology for Energy Corporation, Knoxville, Tennessee, September, 1984

8. WHC-SA-0833-S, Probabilistic Evaluation of Sodium Leaks and Leak Detection Efficiency at the Fast Flux Facility, N.T. Saltos and T.M. Burke, January, 1990

9. WHC-SD-FF-ER-099, Interim Storage of Sodium in Ferritic Steel Tanks at Ambient Temperature, L.D. Blackburn, September, 1994

10. WHC-SD-FF-CDR-006, Conceptual Design Report for the Sodium Storage Facility

APPENDICES

A. EHSC Calculations

B. Preliminary Safety Equipment List

C. Probability Evaluations and Sources

APPENDIX A

ADVERSE ENVIRONMENTAL IMPACT FROM NONRADIOLOGICAL HAZARDOUS MATERIALS SAFETY CLASSIFICATION METHODOLOGY
(sheet 1 of 6)

1. MATERIAL FORM

   a. Is the nonradiological hazardous material dispersible (i.e., other than a consolidated or stabilized solid)? Dispersible materials include liquids, sludges, gases, powders and unconsolidated solids.

      [ ] No - Do not proceed further. The associated systems, components and structures are occupational safety, other criteria permitting.

      [X] Yes - Proceed.

   b. Are only inert gases (e.g., He and Ar) or other environmentally benign gases (e.g., O_2, N_2, CO_2 and CO) present?

      [ ] Yes - Do not proceed further. Systems, components and structures associated with these gases are occupational safety, other criteria permitting.

      [X] No - Proceed.

2. QUANTITY OF NONRADIOLOGICAL HAZARDOUS MATERIAL RELEASED

   a. Nonradiological hazardous materials with Reportable Quantity (RQ) values in 40 CFR Part 302 (the following provides a calculation of 10 times the sum of the number of Final RQs postulated to be released to the environment from the system(s), component(s), and/or structure(s) of interest):

	Category[1]	Amount Released (pounds)	Multiply By[2]		
	X	______	1/1	=	______
	A	______	1/10	=	______
	B	______	1/100	=	______
NaOH	C	2.2×10^6	1/1000	=	2.2×10^3
	D	______	1/5000	=	______

SUM of 2.a multiplying factors = 2.2×10^3 x 10 = 2.2×10^4

[1]From 40 CFR Part 302.
[2]Denominator is Final RQ in pounds for the given category.

APPENDIX A

ADVERSE ENVIRONMENTAL IMPACT FROM NONRADIOLOGICAL HAZARDOUS MATERIALS SAFETY CLASSIFICATION METHODOLOGY
(sheet 2 of 6)

b. Nonradiological hazardous materials of regulatory/environmental concern that are not listed in 40 CFR Part 302.

1. <u>More</u> Environmental Hazard Category

   - Compounds known to be highly environmentally persistent, based on biodegradability.
   - Heavy metals and other metals with known environmental toxicological characteristics.
   - Polycyclic compounds (contain multiple benzene-type rings).
   - Halogenated hydrocarbons.
   - Environmental pathogens (virus or bacteria), engineered organisms, and recombinant DNAs.

2. <u>Less</u> Environmental Hazard Category

   - Compounds known to be somewhat environmentally persistent, based on biodegradability.
   - Petroleum products.
   - Paints and solvents.
   - Pesticides, herbicides, and fungicides.

NOTE: This is not an all inclusive list of nonradiological hazardous materials that are not listed in 40 CFR Part 302. Individual materials may need to be evaluated to assess their environmental hazard.

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ADVERSE ENVIRONMENTAL IMPACT FROM NONRADIOLOGICAL HAZARDOUS MATERIALS SAFETY CLASSIFICATION METHODOLOGY
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Environmental Hazard

Quantity of Each Material[3]	Multiplying Factor Less Category	Multiplying Factor More Category
≤100 gal., 380 L, 840 lbs.[4]	1	10
>100 - 1,000 gal., etc.	2	20
>1,000 - 10,000 gal., etc.	5	50
>10,000 gal., etc.	10	100

SUM of 2.b multiplying factors = N/A

3. TOTAL QUANTITY OF NONRADIOLOGICAL HAZARDOUS MATERIAL RELEASED[5]

Quantity	Multiplying Factor
≤100 gal., 380 L, 840 lbs.	1
>100 - 1,000 gal., etc.	5
>1,000 - 5,000 gal., etc.	10
>5,000 - 10,000 gal., etc.	50
>10,000 - 50,000 gal., etc.	100
>50,000 gal., etc.	500

3. multiplying factor = 500

4. PROXIMITY TO ENVIRONMENTAL RECEIVERS

a. Depth to Aquifer (feet)

Depth to Aquifer (feet)	Multiplying Factor
1. >150	1
2. >75 - 150	2
3. >20 - 75	5
4. 0 - 20	10

4.a multiplying factor = 1

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[3]Quantity is that amount (total volume or total weight depending on units) of each nonradiological hazardous material (not listed in 40 CFR Part 302, but addressed immediately above) postulated to be released to the environment.

[4]Specific gravity of 1 at 4° C and atm. pressure.

[5]The total amount (total volume or total weight depending on units) of nonradiological hazardous material postulated to be released to the environment.

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ADVERSE ENVIRONMENTAL IMPACT FROM NONRADIOLOGICAL HAZARDOUS MATERIALS
SAFETY CLASSIFICATION METHODOLOGY
(sheet 4 of 6)

b. Distance to Sensitive[6] Surface Water — Multiplying Factor

Distance to Sensitive Surface Water	Multiplying Factor
1. >2 miles	1
2. >1.5 - 2 miles	3
3. >2500 feet - 1.5 miles	6
4. >1000 feet - 2500 feet	9
5. >500 feet - 1000 feet	16
6. 100 feet - 500 feet	20
7. <100 feet	25
8. Direct discharge to surface water	50

4.b multiplying factor = 1

c. Distance to Offsite Boundary (miles) — Multiplying Factor

Distance to Offsite Boundary (miles)	Multiplying Factor
1. >10	1
2. >6-10	2
3. >3-6	5
4. 0-3	10

4.c multiplying factor = 5

6. CALCULATION OF ENVIRONMENTAL IMPACT FOR SAFETY CLASSIFICATION

The environmental hazard safety classification (EHSC) is determined as follows where each term is the multiplying factor from the respective paragraphs above.

EHSC = (2.a + 2.b)(3.)(4.a*)(4.b*)(4.c*)

EHSC = (2.2×10^4)(500)(1)(1)(5) = 5.5×10^7

"*" - Term is applied where legitimate pathways to the environmental receivers exist.

NOTE: Based on the chemicals involved, the multiplying factors for terms 2.a or 2.b may not apply.

[6]Example sensitive surface waters are the Columbia River and West Lake.

APPENDIX A

ADVERSE ENVIRONMENTAL IMPACT FROM NONRADIOLOGICAL HAZARDOUS MATERIALS SAFETY CLASSIFICATION METHODOLOGY

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EHSC $\geq$ 1,000,000 = safety significant category

EHSC < 1,000,000 = occupational safety category

NOTES:

1. A nonradiological hazardous material in gaseous form does not have a pathway to an aquifer and is considered for impacting sensitive surface waters (e.g., the Columbia River) or the offsite environment only when the gas was released in a state that promotes a high rate of condensation to a liquid under ambient air conditions.

2. A nonradiological hazardous liquid material is considered to impact sensitive surface waters only when real pathways to those surface waters exist, e.g., through runoff based on the local topography. Legitimate pathways, including close proximity, must also be present to consider the offsite boundary criteria for nonradiological hazardous material in liquid form.

3. In the process of determining potential nonradiological hazardous material pathways to the environment and the quantity and nature of the release (the source term), consideration should be given to the material's physical and chemical characteristics. Examples include:

   - Operating pressure at the point of initial release.
   - Operating temperature at the point of initial release.
   - Boiling point.
   - Autoignition temperature.
   - Detonation capability when exposed to air (under confined and unconfined conditions).
   - Flashpoint when a fire may exist as part of a postulated accident scenario.

APPENDIX A

ADVERSE ENVIRONMENTAL IMPACT FROM NONRADIOLOGICAL HAZARDOUS MATERIALS SAFETY CLASSIFICATION METHODOLOGY

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4. The physical characteristics of nonradiological hazardous sludges, powders, and unconsolidated solids should be evaluated in terms of dispersibility and legitimate pathways to potential receivers, i.e., aquifers, sensitive surface waters or the offsite environment.

5. In the process of determining safety classification for systems and components (e.g., tanks) that contain chemicals, consideration should be given to the mixing of different chemicals associated with the failure of components under natural phenomena or accident conditions. New chemical compounds formed as a result of mixing the contents of failed components may be substantially more hazardous and have a more conservative RQ value.

6. Applicable administrative controls (e.g., mass balance checks during transfers) and leak detection should be considered in the process of determining the amount of nonradiological hazardous material postulated to be released to the environment (release fraction), e.g., due to failures in waste transfer systems between tank farms and processing facilities and due to tank leakage. The accuracy of administrative controls, such as mass balance checks, should also be taken into account when determining the source term.

7. Should the above safety classification methodology provide a result that does not intuitively make sense, more rigorous modelling and evaluation may be required to make a more appropriate determination. Justification shall be provided in the related analysis for deviating from this attachment.

APPENDIX A

ADVERSE ENVIRONMENTAL IMPACT FROM RADIOACTIVE MATERIALS SAFETY CLASSIFICATION METHODOLOGY

(sheet 1 of 4)

1. MATERIAL FORM

Is the radioactive material dispersible (i.e., other than a consolidated or stabilized solid)? Dispersible materials include liquids, sludges, gases, powders and unconsolidated solids.

[ ] No - Do not proceed further. The associated systems, components and structures are occupational safety, other criteria permitting.

[X] Yes - Proceed.

2. QUANTITY AND HALF-LIFE CONSIDERATIONS

The following matrix provides multiplying factors which are a function of the total estimated curie content postulated to be released to the environment from the system(s), component(s), and/or structure(s) of interest. These multiplying factors consider the half-life of the radioisotopes that are present. The curie content of the radioisotopes in each half-life category should be summed and used accordingly.

		Half-life	
Amount (Ci)	<1 yr.[1]	1-100 yrs.	>100 yrs.
Cs^{137} Pu^{239} 10	1	10	100
H^3 10 - 100	5	50	500
Na^{22} 100 - 1000	10	100	1000
10^3 - 10^4	50	500	5000
10^4 - 10^5	100	1000	10,000
10^5 - 10^6	500	5000	50,000
> 10^6	1000	10,000	100,000

SUM of 2. multiplying factors = 215

[1]Tritium is included in this category as an exception.

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ADVERSE ENVIRONMENTAL IMPACT FROM RADIOACTIVE MATERIALS
SAFETY CLASSIFICATION METHODOLOGY
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3. TOTAL QUANTITY OF RADIOACTIVE MATERIAL RELEASED[2]

Quantity	Multiplying Factor
≤100 gal., 380 L, 840 lbs.[3]	1
>100 - 1,000 gal., etc.	5
>1,000 - 5,000 gal., etc.	10
>5,000 - 10,000 gal., etc.	50
>10,000 - 50,000 gal., etc.	100
>50,000 gal., etc.	500

3. multiplying factor = 500

4. PROXIMITY TO ENVIRONMENTAL RECEIVERS

a.

Depth to Aquifer (feet)	Multiplying Factor
1. >150	1
2. >75 - 150	2
3. >20 - 75	5
4. 0 - 20	10

4.a multiplying factor = 1

b.

Distance to Sensitive Surface Water (feet)[4]	Multiplying Factor
1. >2500	1
2. >1000 - 2500	9
3. >500 - 1000	16
4. 100 - 500	20
5. <100	25
6. Direct discharge to surface water	50

4.b multiplying factor = 1

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[2]The total amount (total volume or total weight depending on units) of radioactive material postulated to be released to the environment.

[3]Specific gravity of 1 at 4° C and atm. pressure.

[4]Airborne pathways do not apply for this sensitive surface water or offsite boundary criteria (refer to Table 1, criterion 2.d). Example sensitive surface waters are the Columbia River and West Lake.

APPENDIX A
ADVERSE ENVIRONMENTAL IMPACT FROM RADIOACTIVE MATERIALS SAFETY CLASSIFICATION METHODOLOGY
(sheet 3 of 4)

c. Distance to Offsite Boundary (feet)[4]

	Distance to Offsite Boundary (feet)	Multiplying Factor
1.	>2500	1
2.	1000 - 2500	5
3.	<1000	10

4.c multiplying factor = 1.

5. CALCULATION OF ENVIRONMENTAL IMPACT FOR SAFETY CLASSIFICATION

The environmental hazard safety classification (EHSC) is determined as follows where each term is the multiplying factor from the respective paragraphs above.

EHSC = (2.)(3.)(4.a*)(4.b*)(4.c*)

EHSC = (215)(500)(1)(1)(1) = 1.07X10^5

"*" - Term is applied where legitimate pathways to the environmental receivers exist.

EHSC ≥ 1,000,000 = safety significant category

EHSC < 1,000,000 = occupational safety category

NOTES:

1. A radioactive material in liquid form is considered to impact sensitive surface waters only when real pathways to those surface waters exist, e.g., through runoff based on the local topography. Legitimate pathways, including close proximity, must also be present to consider the offsite boundary criteria for radioactive material in liquid form.

[4] Airborne pathways do not apply for this sensitive surface water or offsite boundary criteria (refer to Table 1, criterion 2.d). Example sensitive surface waters are the Columbia River and West Lake.

APPENDIX A

ADVERSE ENVIRONMENTAL IMPACT FROM RADIOACTIVE MATERIALS SAFETY CLASSIFICATION METHODOLOGY
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2. In the process of determining potential radioactive material pathways to the environment and the quantity and nature of the release (the source term), consideration should be given to the material's physical and chemical characteristics. Examples include:

   - Operating pressure at the point of initial release.
   - Operating temperature at the point of initial release.
   - Boiling point.
   - Autoignition temperature.
   - Detonation capability when exposed to air (under confined and unconfined conditions).
   - Flashpoint when a fire may exist as part of a postulated accident scenario.

3. The physical characteristics of radioactive sludges, powders and unconsolidated solids should be evaluated in terms of dispersibility and legitimate pathways to potential receivers, i.e., aquifers, sensitive surface waters or the offsite environment.

4. Applicable administrative controls (e.g., mass balance checks during transfers) and leak detection should be considered in the process of determining the amount of radioactive material postulated to be released to the environment (release fraction), e.g., due to failures in waste transfer systems between tank farms and processing facilities and due to tank leakage. The accuracy of administrative controls, such as mass balance checks, should also be taken into account when determining the source term.

5. Should the above safety classification methodology provide a result that does not intuitively make sense, more rigorous modelling and evaluation may be required to make a more appropriate determination. Justification shall be provided in the related analysis for deviating from this attachment.

APPENDIX B

PRELIMINARY SAFETY EQUIPMENT LIST (SEL)

SODIUM STORAGE FACILITY

Component or Structure	Safety Class
Sodium Storage Tank #1, foundation & anchor bolts	2
Sodium Storage Tank #2 " " "	2
Sodium Storage Tank #3 " " "	2
Sodium Storage Tank #4 " " "	2
Vacuum pump	4
HEPA Filter	3
Ventilation Relief Damper	3
Furnaces	4
Ventilation Ductwork	4
Ventilation Supply Dampers	4
Transformer	4
Trace Heat Controller	4
Trace Heating Elements, tank	4
Trace Heat Thermocouples, tank	4
Tank Insulation	4
Oxygen Monitors	3
Smoke Detector, linear beam transmitters, relays and alarm unit	3
Fire Alarm Panel	3
Fire Alarm Relay Panel	3
Lighting, general	4
Emergency Lights	3
Exit Lights	3
Emergency Fire Alarm Pull Stations	3

APPENDIX B (Continued)

Tank Relief Valves	3
Tank Rupture Discs	3
Tank Relief Piping to Relief Valve	3
Tank Relief Duct	3
Tank Relief Pressure Switch(s)	3
Tank Relief Piping Isolation Valve(s)	3
Tank Pressure Indicators	3
Tank Level Indicators	4
Tank Internal Thermocouples	4
Sodium Piping and supports	3
Sodium Valves	3
Anti-siphon Piping	3
Anti-siphon Valve	3
Inert Gas Piping	3
Inert Gas Valves	3
Inert Gas Regulator Station	3
Inert Gas Pressure Indicator	3
Seaton-Wilson Quick-disconnect	3
Piping Trace Heat	4
Piping Thermocouples	4
Piping Insulation	4
Piping Trace Heat Controllers	4
Foundations, poured in-place	3/2 Seismic/wind
Walls, poured in-place	3/2 Seismic/wind
Roof Support Beam, precast	3/2 Seismic/wind
Roof Panels, precast	3/2 Seismic/wind
Mezzanine, support steel	3/2 Seismic

APPENDIX B (Continued)

Mezzanine, floor & walls concrete	3/2 Seismic
Mezzanine, tank access plates	3/2 Seismic
Roof coating system	4
Stairs	3
Ladder	3
Drip Pan	3
Drip Pan Cover, support steel	3
Drip Pan Cover, grating	3
Drip Pan Cover, steel plate	3
Access Doors	3
Sheet Metal Enclosures, stairs & rooms	4
Enclosures, support steel,	4
Roll-up Door	4
Jib Hoist	3
Electrical Room Air Conditioner	4
Stair Enclosure Vent Fans	4
Stair Enclosure Louvers	4
Stair Enclosure Unit Heaters	4

APPENDIX C

PROBABILITY EVALUATION AND SOURCES

Earthquake probability -

Reference 3 - Safety Class 2 earthquake - 0.12 g

Reference 4 - Figure 3, for 0.12 g earthquake and 400 Area curve, determine $\underline{2.5 \times 10^{-4}/yr}$ probability

Extreme Wind probability -

Reference 3 - Safety Class 2 wind - 80 mph

Reference 5 - Table 5-1
for Hanford Project Site
77 mph - 10^{-4}/yr probability
85 mph - 10^{-5}/yr probability
80 mph - $\underline{5 \times 10^{-5}/yr}$ interpolated Earthquake bounds

Overpressurize tank and relief valve fail open -

Reference 6 - Relief valve or rupture disc fail to open (in series)
3×10^{-3} per demand - each component fails
6×10^{-3} per demand - either component fails
Reference 6 - Regulator fails open - 5×10^{-6}/yr
Cumulative probability - $\underline{3 \times 10^{-8}/yr}$

APPENDIX C (continued)

Piping, Valves and Tank Leaks and Ruptures Due to Metal Failure -

Reference 7, CRBRP PRA, Table 9.2-3 - Failure rates per hour per cell

- **Piping** is based on linear feet in cell -
  - Rate per foot is 2.1 x 10^{-13}/yr
  - High point piping in SSF is 400 feet long
  - Hourly rate - 8.4 x 10^{-11}/hr Yearly rate - 7.4 x 10^{-7}/yr
  - Above based on CRBRP using ASME Section III quality piping and large bore
  - SSF uses small bore piping and ANSI/ASME B31.1
  - Conservatively, at least 10 times more probable or 1 x 10^{-5}/yr
  - Low point piping is 200 feet long, but assume same probability
- **Rupture probability**
  - Reference 10 concludes 10^{-10}/yr
- **Valves**
  - Reference 8, Table 9.2-3
  - Cell 208 - 4 valves as in SSF - 4 x 10^{-8}/hr
  - Yearly rate - 3.5 x 10^{-4}/yr
- **Tanks**
  - Each molten for 3 months, 4 tanks for one year
  - Reference 8, Table 9.2-3
  - Ex-Vessel Storage Tank (used in SSF) - 8.5 x 10^{-8}/hr
  - Yearly rate - 7.5 x 10^{-4}/yr
  - Reference 9 concludes $<10^{-5}$/yr
  - Use 1 x 10^{-5}/yr for SSF vessels due to low temperature and fewer thermal transients at reduced rates