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SAFETY EVALUATION FOR PACKAGING FOR THE 1720DR
SODIUM FILLED TANK

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1		Safety: DW McHardy	<i>D. McHardy</i>	3/6/96	01-11						
1		JA Deritor	<i>J. Deritor</i>	3/17/96	05-31						
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Safety Evaluation for Packaging for the 1720-DR Sodium-Filled Tank

M. S. Mercado

Westinghouse Hanford Company, Richland, WA 99352
U.S. Department of Energy Contract DE-AC06-87RL10930

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Abstract: Preparations are under way to sell the sodium stored in the 1720-DR tank in the 1720 DR building. This will require that the tank, as well as the 1720-DR facility, be moved to the 300 Area, so that the sodium may be melted and transferred into a railroad tanker car. Because the sodium is a hazardous material and is being shipped in a nonspecification packaging, a safety evaluation for packaging (SEP) is required. This SEP approves the sodium-filled tank for a single shipment from the 105 DR area to the 300 Area.

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V. L. Burkland 3/8/96
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LIST OF TERMS

ASME	American Society of Mechanical Engineers
DOT	U.S. Department of Transportation
gal	gallon
HMT	Hazardous Materials Table
in.	inch
lb	pound
NE	Nuclear Energy
psig	pounds per square inch, gage
SFP	safety evaluation for packaging
UT	ultrasonic testing

SAFETY EVALUATION FOR PACKAGING FOR THE 1720-DR SODIUM-FILLED TANK

1.0 INTRODUCTION

The 1720 DR sodium-filled tank was procured as excess from the Ferni reactor and shipped to Hanford in the early 1970s. The tank is fabricated from 304 stainless steel, and is 8 ft in diameter by 16 ft long. The tank is located in the 1720-DR building, which is adjacent to the 105-DR reactor building. The building is a small sheet metal building. Within this building, the tank sits in a 3.5-ft-deep, carbon steel lined pit.

The sodium continues to be managed under the Nuclear Energy (NE) Legacy Program as part of the nonradioactive NE legacy sodium by Westinghouse Hanford Company. The sodium was anticipated for use in sodium aerosol burn tests, subjecting Fast Flux Test Facility materials of construction to sodium test environments; however, the tests were never conducted, and the sodium was never used.

Preparations are now under way to sell the sodium. This will require that the tank, as well as the 1720-DR facility, be moved to the 300 Area, so that the sodium may be melted and transferred into a railroad tanker car. Because the sodium is a hazardous material and is being shipped in a packaging not specifically authorized by the U.S. Department of Transportation (DOT), a safety evaluation for packaging (SEP) is required. This SEP authorizes the sodium-filled tank for a single onsite shipment from the 105-DR area to the 300 Area.

2.0 PACKAGING SYSTEM

The tank is 8 ft in diameter and 16 ft long and is constructed from 1/2-in.-thick 304 stainless steel. The tank has ten 8-in.-diameter flanged openings and one 27-in.-diameter flanged opening, all on top of the tank. The capacity of the tank is 6,000 gal. It was designed to the 1952 *ASME Boiler and Pressure Vessel Code* and is rated at 100 psi and 600 °F (see Appendix C). The tank weighs approximately 26,000 lb empty and approximately 65,000 lb with the sodium. There is no visible fabrication stamp or marking.

The tank sits on a skid, which supports the tank in three separate spots. The skid is fabricated of carbon steel and consists of three saddles connected by two longitudinal beams. The center saddle is welded to the tank. The welds are 3/16-in. fillet welds 2-1/4 in. long, and there are two of these welds on each side of the center saddle.

3.0 PACKAGE CONTENTS

The contents of the tank is 39,000 lb (approximately 4,800 gal) of solid sodium metal. The sodium is ultra pure. It was never used in any system onsite and is radiologically clean. The tank has been purged with argon at 1.2 psig, and appropriate measures will be taken to ensure continuity of the purge (see 5.0).

4.0 TRANSPORT SYSTEM

The tank shall be supported on a trailer of appropriate capacity for the weight of the tank, the sodium, and the tiedowns (approximately 66,000 lb). The trailer shall be such that the Hanford Site weight and size restrictions are met (contact Kaiser Engineers Hanford, Fleet Operations, for specifics). The tank shall be tied down in accordance with DOT regulations (49 CFR 393, Subpart I). A recommended tiedown configuration (shown in Figure 1) has been analyzed (see Appendix A) and meets these requirements. Alternative tiedown configurations are acceptable, provided that the configuration has been shown to meet 49 CFR 393, Subpart I.

NOTE: Due to the limited number and size of welds between the skid and the tank, attachments to the skid shall only be used for restraint in the lateral direction; i.e., perpendicular to the direction of travel.

5.0 ACCEPTANCE OF PACKAGING FOR USE

The sodium tank will be evaluated against the applicable requirements for a DOT-approved portable tank. The requirements are taken from the 49 CFR 172.101 Hazardous Materials Table (HMT).

The HMT allows several bulk packagings, as listed in 49 CFR 173.244. Among the allowable packagings are a DOT specification 51 portable tank. The requirements for a DOT 51 portable tank are given by 49 CFR 178.245.

The HMT also invokes certain special provisions per 49 CFR 172.102.

Each of the requirements is given, followed by a discussion of how each requirement is being addressed. The requirements and discussions are as follows.

5.1 49 CFR 178.245-1(a)

"Tanks must be seamless or welded steel construction or combination of both and have a water capacity in excess of 1,000 pounds. Fusion welded tanks must be postweld heat treated and radiographed as

Figure 1. Recommended Tiedown Configuration.

prescribed in the ASME Code except that each tank constructed in accordance with Part UPT of the ASME Code must be postweld heat treated. Where postweld heat treatment is required, the tank must be treated as a unit after completion of all the welds in and/or to the shell and heads. The method must be as prescribed in the ASME Code. Welded attachments to pads may be made after postweld heat treatment is made. A tank used for anhydrous ammonia must be postweld heat treated. The postweld heat treatment must be as prescribed in the ASME Code, but in no event at less than 1050 degrees F. tank metal temperature.'

This requirement is met. The tank is made from welded 304 stainless steel. It has a capacity of 6,000 gal. Because it is fabricated from an austenitic stainless steel, postweld heat treating is not required. Weld integrity has been verified by ultrasonic testing (UT) in addition to any radiographs at the time of manufacture. The UT report is Appendix B.

5.2 49 CFR 178.245-1(a)(1)

"Tanks constructed in accordance with Part UHT of the ASME Code must conform to the following requirements: Welding procedure and welder performance tests must be made annually in accordance with section IX of the ASME Code. In addition to the essential variables named therein the following must be considered to be essential variables: Number of passes, thickness of plate, heat input per pass, and manufacturer's identification of rod and flux. The number of passes, thickness of plate and heat input per pass may not vary more than 25 percent from the procedure qualification. Records of the qualification must be retained for at least 5 years by the tank manufacturer and made available to duly identified representatives of the Department of Transportation or the owner of the tank."

This requirement is not applicable. Part UHT only applies to materials whose tensile properties are enhanced by heat treatment. The sodium tank is an austenitic stainless steel; therefore, its tensile properties cannot be enhanced by heat treatment.

5.3 49 CFR 178.245-1(a)(2)

"Tanks constructed in accordance with Part UHT of the ASME Code must conform to the following requirements: Impact tests must be made on a lot basis. A lot is defined as 100 tons or less of the same heat and having a thickness variation no greater than plus or minus 25 percent. The minimum impact required for full-sized specimens shall be 20 foot-pounds (or 10 foot-pounds for half-sized specimens) at 0 degrees F. Charpy V-Notch in both the longitudinal and transverse direction. If the lot test does not pass this requirement, individual plates may be accepted if they individually meet this impact requirement."

This requirement is not applicable. Part UHT only applies to materials whose tensile properties are enhanced by heat treatment. The sodium tank is an austenitic stainless steel; therefore, its tensile properties cannot be enhanced by heat treatment.

5.4 49 CFR 178.245-1(b)

"Except as noted below, all openings in the tank shall be grouped in one location, either at the top of the tank or at one end of the tank. Exceptions: (1) The openings for liquid level gauging devices, or for safety devices, may be installed separately at the other location or in the side of the shell; (2) one plugged opening of 2-inch National Pipe Thread or less provided for maintenance purposes may be located elsewhere; (3) an opening of 3-inch National Pipe Size or less may be provided at another location, when necessary, to facilitate installation of condensing coils."

This requirement is met. All openings are at the top.

5.6 49 CFR 178.245-1(c)

"Each uninsulated tank used for the transportation of compressed gas, as defined in Sec. 173.300 of this subchapter, must have an exterior surface finish that is significantly reflective such as a light reflecting color if painted, or a bright reflective metal or other material if unpainted."

This requirement is not applicable. The tank will hold 1-2 psig of argon, and per the definition of 49 CFR 173.115, this is not considered a compressed gas.

5.6 49 CFR 178.245-2(a)

"All material used for the construction of the tank and appurtenances shall be suitable for use with the commodity to be transported therein."

This requirement is met. The tank is fabricated from 304 stainless steel, which is compatible with sodium metal, and is as required by 49 CFR 172.102, special provision B28.

5.7 49 CFR 178.245-2(b)

"A material of thickness less than 3/16 inch shall not be used for the shells and heads."

This requirement is met. The shell and heads are fabricated from 1/2-in. thick wall material. This has been verified via UT to check material thickness. The UT report is Appendix B.

5.8 49 CFR 178.245-3(a)

"The design pressure of a tank authorized under this specification shall be not less than the vapor pressure of the commodity contained therein at 115 degrees F., or as prescribed for a particular commodity by Part 173 of this chapter, except that in no case shall the design pressure of any container be less than 100 psig or more than 500 psig. When corrosion factor is prescribed by these regulations, the wall thickness of the tank calculated in accordance with the 'Code' (see Sec. 178.245-1(a)) shall be increased by 20 percent or 0.10 inch, whichever is less."

This requirement is met. The vapor pressure of sodium (defined as the pressure exerted when a solid or liquid is in equilibrium with its own vapor) is very low. A conservative value would be 1mm Hg (i.e. 0.02 psi), which is the value for liquid sodium at 824 °F. The sodium will be shipped as a solid; therefore, the vapor pressure would be much less. The argon pressure will be 1-2 psig, and the tank is designed for 100 psi. There is no corrosion factor prescribed by the regulations.

5.9 49 CFR 178.245-4(a)

"Tanks shall be designed and fabricated with mountings to provide a secure base in transit. 'Skids' or similar devices shall be deemed to comply with this requirement."

This requirement is met. The tank is welded to a skid, as described in Section 2.0.

5.10 49 CFR 178.245-4(b)

"All tank mountings such as skids, fastenings, brackets, cradles, lifting lugs, etc., intended to carry loadings shall be permanently secured to tanks in accordance with the requirements of the Code under which the tanks were fabricated and shall be designed to withstand static loadings in any direction equal to twice the weight of the tank and attachments when filled with the lading using a safety factor of not less than four, based on the ultimate strength of the material to be used. The specific gravity used in determining the static loadings shall be shown on the marking required by Sec. 178.245-6(a) and on the report required by Sec. 178.245-7(a)."

This requirement is not met. Only the center support is welded to the tank, however, the recommended tiedown configuration is such that it does not rely on the strength of these welds. Although not specifically analyzed, the skid was evaluated as adequate for these loads.

5.11 49 CFR 178.245-4(c)

"Lifting lugs or hold-down lugs may be added to either the tank or tank mountings. If lifting lugs and hold-down lugs are added directly to the tank, they shall be secured to doubling plates welded to the tank and located at points of support, except that lifting lugs or hold-down lugs with integral bases serving as doubling plates may be welded directly to the tank. Each lifting lug and hold-down lug shall be designed to withstand static loadings in any direction equal to twice the weight of the tank and attachments when filled with the lading using a safety factor of not less than four, based on the ultimate strength of the material to be used."

This requirement is met. There are no lifting or hold down lugs.

5.12 49 CFR 178.245-4(d)

"All tank mountings shall be designed so as to prevent the concentration of excessive loads on the tank shell."

This requirement is met. Load distribution is assured by the skid, which supports the tank in three places.

5.13 49 CFR 178.245-5(a)

"All valves, fittings, accessories, safety devices, gaging devices, and the like shall be adequately protected against mechanical damage."

This requirement is met. The only fittings are the flanged openings, which are located at the top and are therefore not subject to inadvertent mechanical damage in transport.

5.14 49 CFR 178.245-5(b)

"The protective device or housing shall comply with the requirements under which the tanks are fabricated with respect to design and construction, and shall be designed to withstand static loadings in any direction equal to twice the weight of the tank and attachments when filled with the lading using a safety factor of not less than four, based on the ultimate strength of the material to be used."

This requirement is met. There are no protective devices or housings.

5.15 49 CFR 178.245-5(c)

"Requirements concerning types of valves, retesting, and qualification of portable tanks contained in Sec. 173.32 and 173.315 of this chapter must be observed."

This requirement shall be met. There are no valves. The 173.32 retesting requirements are pressure testing and visual inspection every five years. The tank shall be visually inspected prior to transport, as required by 6.0. Per 49 CFR 172.102, special provision B48, visual tests may conducted in lieu of pressure tests. The qualification requirements authorize a DOT specification 51 tank. Section 173.315 is not applicable (compressed gases only).

5.16 49 CFR 178.245-6(a)

"In addition to the markings required by the Code (see Sec. 178.245-1(a)) under which tanks were constructed, they shall have permanently affixed, on one of the heads of the tank, a metal plate. This plate shall be permanently affixed by means of soldering, brazing, or welding around its complete perimeter. Neither the plate itself nor the means of attachment to the tank shall be subject to destructive attack by the contents of tank. Upon such plate shall be plainly marked by stamping, embossing, or other means of forming letters into or onto the metal plate itself the following information in characters at least 1/8-inch high (Manufacturer's name, Serial No., Owner's serial No., D.O.T. Specification No., Water capacity (pounds), Tare weight (pounds), Design pressure (psig), Design specific gravity, Original test date, Tank retested at - - - (psig) on - - -):"

This requirement is not met; however, the capacity, weight, and design pressure are provided in Appendix C, and the absence of the information plate will not affect the safety of the shipment.

5.17 49 CFR 178.245-6(b)

"All tank outlets and inlets, except safety relief valves, shall be marked to designate whether they communicate with vapor or liquid when the tank is filled to the maximum permitted filling density."

This requirement is not met; however, the tank will never be completely full, the material is solid, and the openings will not be used during transportation.

5.18 49 CFR 178.245-7(a)

"A copy of the manufacturer's data report required by the Code (Sec. 178.245-1(a)) under which the tank is fabricated shall be furnished to the owner for each new tank. "

It is not known if this requirement was met. The manufacturer's data report or certificate of compliance is no longer available due to the age of the tank; however, the capacity, weight, design pressure and ASME code compliance are provided in Appendix C.

5.19 49 CFR 172.102

Special provisions A7, A8, A19, A20, N34, T15, T29, and T46.

These requirements are not applicable. Per 49 CFR 172.102 the "A" provisions are for transportation by aircraft, the "N" provision is for non-bulk packagings, and the "T" provisions are for intermediate bulk containers. A DOT 51 tank is considered to be a bulk packaging.

5.20 49 CFR 172.102

Special provision B9:

"Bottom outlets are not authorized."

This requirement is met. There are no bottom outlets.

5.21 49 CFR 172.102

Special provision B28:

"Packagings must be made of stainless steel."

This requirement is met. The tank is made of 304 stainless steel.

5.22 49 CFR 172.102

Special provision B48:

"Portable tanks in sodium metal service may be visually inspected at least once every five years instead of being retested hydrostatically. Date of the visual inspection must be stencilled on the tank near the other required markings."

This requirement shall be partially met. The tank shall be visually inspected prior to shipping, as required by 6.0, and the date shall be recorded on the inspection report; however, the date stencil is optional (because it does not affect the safety of the shipment, and the tank will be taken out of service after this shipment).

5.23 49 CFR 172.102

Special provision B68:

"Sodium must be in a molten condition when loaded and allowed to solidify before shipment. Outage must be at least 5% at 96°C (208°F). Bulk packagings must have exterior heating coils fusion welded to the tank shell which have been properly stress relieved. The only tank car tanks authorized are Class DOT 105 tank cars having a test pressure of 2,069 kPa (300 psig) or greater."

This requirement is met. The sodium will be solid during shipment. The tank is only 80% full. There are 20 exterior heating coils. The tank is not a tank car tank.

5.24 49 CFR 172.102

Special provision B100:

"Intermediate bulk containers are not authorized."

This requirement is met.

6.0 SUMMARY

The sodium tank was evaluated against the requirements for a DOT-approved sodium metal tank, and it was determined that, with certain restrictions, the tank will provide a degree of safety that is equivalent to that provided by a DOT specification 51 tank. The restrictions are as follows.

- Prior to shipment, the tank shall be purged and pressurized with argon to a pressure of 1-2 psig. The ability of the tank to maintain argon pressure during transportation shall be ensured, either by pressure drop tests or other operational data. A pressure gauge shall be attached to the tank, and the pressure shall be verified immediately before transport.
- The tank shall be tied down per Section 4.0 of this SEP.
- The external surfaces of the tank, the flanged openings, and the skid shall be visually inspected for damage or deterioration. Special attention shall be paid to all welds and to the flanged openings. The inspection results shall be formally documented prior to shipment, and any discrepancies shall be resolved.
- The tank shall not be transported on slippery roads or in heavy fog.
- The transporter speed shall be limited to 35 mph, unless a lower speed limit is posted.
- The transporter shall follow Route 2 north and Route 2 south to the Wye Barricade. South of the Wye Barricade, a road closure shall be in effect.
- Emergency responders shall be notified of the shipment and contents.
- The shipment shall be in accordance with the requirements of WHC-CM 2-14, *Hazardous Material Packaging and Shipping*.

7.0 REFERENCES

- 49 CFR 172, 1994, "Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, and Training Requirements," *Code of Federal Regulations*, as amended.
- 49 CFR 173, 1994, "Shippers--General Requirements for Shipments and Packagings," *Code of Federal Regulations*, as amended.
- 49 CFR 178, 1994, "Specifications for Packagings," *Code of Federal Regulations*, as amended.
- 49 CFR 393, 1994, Subpart I, "Protection Against Shifting or Falling Cargo," *Code of Federal Regulations*, as amended.
- WHC-CM-2-14, *Hazardous Material Packaging and Shipping*, Westinghouse Hanford Company, Richland, Washington.

APPENDIX A
TIEDOWN CONFIGURATION ANALYSIS

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DESIGN CALCULATION

(1) Drawing _____ (2) Doc. No. _____ (3) Page 1 of 3
 (4) Building _____ (5) Rev. _____ (6) Job No. B-6015
 (7) Subject TIEDOWN FOR 12,000 gal Sodium Tank
 (8) Originator W. Smith Date 2/9/96
 (9) Checker B.D. Zlaty Date 2/9/96

(10)

DETERMINE THE ADEQUACY OF 12th (WORKING LOAD) CHAIN AS A TIEDOWN FOR THE SODIUM TANK ON THE ATTACHED SKETCH.

THE BASIC TIEDOWN REG'T FOR DOT IS 49 CFR 393.102 (OCT. 1995) -

section b states that the aggregate working load limit is $\frac{1}{2}$ of the weight in any direction. Since there are 4 chains with a working load limit of 12,000 lbf, compute $4 \times 12,000 = 48,000$ lbf with $\frac{1}{2} \times 65,000 = 32,500$ lbf. Since $48,000 > 32,500$ the tiedown is adequate by 49 CFR 393.102(b) standards.

The following is a more detailed engineering evaluation.

1. Longitudinal acceleration: Force in two chains = max working load is

$$F = 12,000$$

$$2 \times \frac{12}{2} \times 12,000 = 16,970 \text{ *}$$

* total horizontal force at working strength of 2 chains

find acceleration so chain tension = working strength

$$\frac{16,970}{65,000} = .26 g$$

This neglects friction. 49 CFR 393.104 (a) requires acceleration = $80/32.2 = .621 g$

2. Lateral acceleration: this is resisted by friction between the tank's skirts & the trailer bed.

DESIGN CALCULATION

(1) Drawing _____ (2) Doc No. _____ (3) Page 2 of 3
 (4) Building _____ (5) Rev. _____ (6) Job No. _____
 (7) Subject _____
 (8) Originator WJS Date 2/3/76
 (9) Checker RF Date 2/3/76

(10)

Lateral overturning is resisted by 4 chains + bracing or friction. In the following, assume no slipping between the trailer & the tank. Find the lateral acceleration req'd to turn over the entire trailer, then find the load in the chain at this acceleration.

Assume: trailer wt is 10,000 lb, cg is 24" from bottom of tank is 48" above ground.

This is conservative since higher CG will show smaller chain load.

for lateral acceleration of L (as a fraction of $1g$) the overturning moment about the loaded wheel is

$$L(65,000 \times 96 + 10,000 \times 24) = 6,090,000 \text{ lb-in} \times L$$

The resisting moment is $48(65,000 + 10,000) = 3,600,000 \text{ lb-in}$.

The max. L is $\frac{3.6 \times 10^6}{6.09 \times 10^6} = .591g$; if L were

higher, the trailer would over turn.

Find the chain tension at $L = .591g$. The vertical force component is F , due to 4 chains

∑ moment @ bottom of tank: $48F = 48 \times 65,000 \times L$

$$F = 65,000 \times .591 = 38,420 \text{ lb}$$

DESIGN CALCULATION

(1) Drawing _____ (2) Doc. No. _____ (3) Page 3 of 3
 (4) Building _____ (5) Rev. _____ (6) Job No. _____
 (7) Subject _____
 (8) Originator U.S. Date 2/2/96
 (9) Checker B.F. Date 2/2/96

(10)

Assuming equal tension in 4 chains, Σ Vertical force is

$$2T + 2T \cdot \frac{\sqrt{2}}{2} = 3.41 T$$

$$T = \frac{F}{3.41} = \frac{38,420}{3.41} = 11,250 \text{ lbf} < \text{working load limit.}$$

Conclusion

In addition to the 4 chains, blocking and bracing must be provided. It must resist a lateral force of $.591 \times 65,000 = 38,420 \text{ lbf}$. The chain will not fail under a 20 ft/sec/sec acceleration, but it will be stressed to $\frac{.621}{.26} = 2.4$ times the working load.

Add lateral restraint chains: 2 each side with a working strength of 12,000 each will not fail at less than $38,420$ lateral force

or more
 Add 2 chains, per side -
 min working strength 12,000
 Each.

- Notes:
1. Chain strength $> 5 \times$ working load
 2. We assume that the trailer tiedown point is as strong as the chain

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APPENDIX B
ULTRASONIC TESTING REPORT

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1720-DR TANK
100-DR

NICK FURTH
JIM DEMETER
2/5/1995

APPENDIX C
SODIUM TANK REPORT

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Westinghouse
Hanford Company

Internal
Memo

From: Engineered Process Applications/Chemical Engineering Lab. 95147JAH
Phone: 376-2356 L5-31
Date: September 29, 1995
Subject: MILESTONE COMPLETION COVER LETTER

To: W. F. Brehm *WFB* N2-36

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This letter transmits the report 'Sodium Tanks 1720-DR and 3718-M Draining Options' as completion of the N. E. Legacy Program (cost account 169503) milestone 669-95-204 - Select Concept for Draining Sodium from 1720-DR and 3718-M Tanks.

If you should have any questions concerning this matter, please contact J. A. Deniter at 376-9671.

Monte Crippen
J. A. Hunter
Manager

K77

Attachments

bcc (information only):

RL - W. A. Ruhlman

KEH - R. L. Wiseman

SODIUM TANKS 1720-DR AND 3718-M DRAINING OPTIONS

1.0 OBJECTIVE AND BACKGROUND

1.1 OBJECTIVE

The objective of this report is to evaluate alternatives for draining the sodium from the 1720-DR building sodium tank and recommend leaving the tank in place or moving it to the 300 Area to accomplish the draining task. Evaluation of each alternative considered Kaiser Hanford work tasks and Westinghouse Hanford Company (WHC) contract work tasks but excluded WHC Program work activities (supplied by WHC EPTF Engineering) and WHC technical support activities (supplied by WHC Engineered Process Applications) since the last two organizational costs will be similar for all alternatives. The evaluation narrowed the alternatives to three: one leaving the tank in place in the 100-DR Area and two options moving the tank into the 300 Area for draining. The report recommends the most feasible alternative for draining the sodium tank based on cost savings potential and safe, effective program coordination to be the 300 Area option #2B.

The draining of the sodium from the 3718-M tank is discussed in the Hanford Site Sodium Management Plan, WHC-SD-SF-MP-001, Revision 1, dated September 26, 1995. The N.E. Legacy Program accepts the document disposition to reheat the sodium in place and transfer it into a railroad tanker car for resale to a buyer. This is the preferred draining option for the 3718-M sodium tank and draining options will not be discussed further in this report.

1.2 BACKGROUND

The 1720-DR sodium filled tank was procured as excess from the Fermi reactor and shipped to Hanford in the early 1970's. This sodium continues to be managed under the Nuclear Energy (NE) Legacy Program as part of the non-radioactive NE Legacy sodium by Westinghouse Hanford Company. The sodium was anticipated for use in sodium aerosol burn tests, subjecting EPTF materials of construction to sodium test environments. The tests were to be conducted in the 105-DR Large Sodium Fire Facility (LSFF). The tests were never conducted and the sodium was never used. The tank was placed in a permanent safe storage condition, where it remains today, by removing the insulation on the tank and maintaining it in the 1720-DR building metal-lined pit with a static argon pressure of 1-2 psi to prevent any air/moisture inleakage.

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1.3 DESCRIPTION

The 1720-DR sodium is contained in a 304 stainless steel cylindrical tank, 8'-0" in diameter, 16'-0" long with a 1/2" wall thickness (see Figure 1). The tank has ten 8" diameter flanged openings and one 27" diameter opening all on the top of the tank. The tank's potential volume is 6,800 gallons but is only filled with 39,000 pounds of metallic sodium (approximately 4,800 gallons). A spectral analysis was conducted on the sodium in 1971, prior to its shipment to Hanford, by Argon East National Laboratory (see Figure 2). The ultra-pure sodium is also radiologically "clean". The tank was designed to 1952 ASME pressure vessel code and is rated at 100 psi at 600 degrees F. The tank and included sodium is estimated to weigh about 65,000 pounds. There is no visible fabrication stamp or marking on the tank.

In 1994 continuity testing was conducted on the 20 external heaters and 16 internal bayonet (unknown voltage) tank heaters. Only four external heaters and 12 of the bayonet heaters had continuity. It was decided the most efficient method to melt the sodium and drain the tank was to install new external heaters and insulate the tank.

1.4 STORAGE

The sodium filled tank is stored in a stable condition in the 1720-DR building located about 10 feet off the SW corner of the 105-DR reactor building. The 1720-DR building is a sheet metal Butler-type building (see Figure 3) set over the 14'-10"W by 22'-10"L by 3'-6" deep carbon steel-lined concrete pit. The building measures 16 feet by 24 feet with a peaked roof rising about 13 feet above grade. The tank sits in the metal-lined pit on three structural steel saddles spaced 5'-6" apart. The metal liner acts as a catch pan and will hold 8,400 gallons of molten sodium. The carbon steel pit liner was ultrasonically examined and is 1/8" thick (see Figure 4). No utilities or services are connected to the building.

1.5 HAZARDS

The potential hazards of the stored sodium tank have been mitigated through administrative controls, engineered barriers and safety training. The mitigation controls include: safe storage practices (stored in metal-lined pit), argon static purge on the tank, lack of utilities to the building thereby eliminating inspection or maintenance by untrained alkali metal personnel, locked facility and key control, inspections by trained personnel only and the physical isolation of the facility.

The general hazards and emergency preparedness required for emergency response in the case of a sodium tank rupture (postulated accident scenario) at 100-DR or the 300 Area are being addressed in the: 1720-DR Sodium Storage Building Hazards Assessment (WHC-SD-PRP-HA-002, Rev.2 - DRAFT) and 300 Area Sodium Storage Facilities Hazards Assessment (WHC-SD-PRP-HA-020, Rev.0).

FIGURE 1

FIGURE 3

Westinghouse Hanford Company		NDE ULTRASONIC MEASUREMENT PROCEDURE AND TEST REPORT <small>NONDESTRUCTIVE EXAMINATION 308 BLDG., 300 AREA - TEL 175-5401</small>			Job No. 95-2	
Requester (Plant)	Company	W/M/N	Reg	Area	PART INFORMATION	
J. A. DENITER	WHC	L5-21	3760	303	Material CST	
Project/System/Work Package/Transfer No.					Wall Thickness ☒ NA	
N.E. LEGACY SODIUM PROGRAM					Diameter ☒ NA	
					Schedule ☒ NA	
					Size ☒ NA	
Acceptance Std.	Section	Para.	Dist.	☒ NA	Dwg. No. ☒ NA	ACR ☒ NA
WIRE PROCEDURE NO.				RESULTS		
NDT-US-9000, Revision No. 3						
Appendix A Revision No. 3						
Spec. Tech. No. ☒ NA						
COVERAGE						
☒ 100% of Area Requested						
☐ Other						
INSTRUMENTATION						
Mfg. ORTEC Model 124-D				1720 DR SODIUM TANK LINER		
Standards Lab No. 584-31-50-024				NORTH WALL .134"		
Expiration Date 11/95				SOUTH WALL .128"		
CALIBRATION STANDARD				EAST WALL .137" AND .130"		
Standards Lab No. 584-99-30-125				WEST WALL .127" AND .127"		
Expiration Date 12/95				FLOOR .137"		
Standards Lab No.						
Expiration Date						
TRANSDUCER						
Geometry 1/2 APPROX						
Frequency 5 MHz						
Mfg. ORTEC						
Serial No. 50767						
Brand CM NONE						
Couplant ULTRAGELL						
Batch No. 8336						
Inspected by		UT Level	Inspected by		UT Level	Reviewed by
JAMES M. FURTH		II	JAMES M. FURTH		II	John H. Kim
Date of examination			Date of examination			
30 AUG 1995			30 AUG 1995			8-31-95

A-6000 E07 IC1.1941

FIGURE 4

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The documents set the emergency response requirements per DOE regulations and mandate a building emergency response warden.

2.0 SUMMARY

This report evaluates alternatives to drain the 1720 DR tank inplace or move the tank to the 300 Area for draining. The evaluation of the alternatives included Kaiser cost and labor data, Westinghouse cost and labor data (excluding WHC EPA and WHC FFTF Engineering costs deemed to be similar at each location of draining) as well as other site and contractor cost and labor data.

Several items of work scope, regardless of draining location, have already been determined. These items include:

- * Kaiser Hanford construction forces will do the work.
- * The sodium will be drained into a railroad tanker car and sold to a buyer.
- * Railroad track will move the railroad tanker car into place; it will not be lifted into position by a crane.
- * New external heaters will be placed on the tank and the tank will be reinsulated.
- * The 1720-DR site will be closed after tank removal.

This report provides cost data for the work activities in FY 1995 dollars even though this sodium draining activity is not scheduled to begin until FY 1993. The Kaiser estimate is a rough order of magnitude and therefore has a 30% contingency.

The alternatives evaluated were: Option #1 - moving a railroad tanker car adjacent to 1720-DR building and transferring the sodium into the rail tanker; Option #2A - transporting the sodium tank, liner and building into the 300 Area, placing it north of the 3718-M building and transferring the sodium into a tanker car and Option #2B - transporting the sodium tank, liner and building into the 300 Area, placing it north of the 336 building and transferring the sodium into a rail tanker car set on an existing rail spur. Other options at the 100-DR site (such as leaving the railroad tanker car outside the reactor fence and fabricating a 250 foot drain line) were omitted. In a like manner, other locations at the 300 Area to spot and drain the tank were not appropriate due to cost, lack of facility support or inadequate space.

Option #1 (see Attachment #1, Kaiser cost data) evaluated heating and draining the 1720-DR tank inplace, moving a rail car tanker adjacent to the building, rinsing the tank inplace, transferring the tank and building to salvage and performing closure activities at the site. The burden of installing over 650 feet of panelized rail track (see Figure 5, point A), repairing and upgrading the rail line from the main line to the 151D spur (about two miles) to Class 1 standards (see Figure 5, point B) and the radiological monitoring adds about \$ 180K in costs to this option. The cost estimate for completing option #1 is estimated at \$ 416.7K. This estimate includes Kaiser construction, off-site contractual work,

NOTE: THIS MAP IS TO BE USED FOR
REFERENCE PURPOSES ONLY. DO NOT USE FOR
CONSTRUCTION PURPOSES.

ICF Kaiser Howard Company
Mapping Services

Scale: 2700:1
Sheet: 9-25-05

Location: J.W. HAMILTON
Project: SAT-1 C. DRAINAGE

Sheet:
1000 AREA

FIGURE 5

Bechtel Hanford contract work and Westinghouse Hanford work scope excluding EPA and FSTF Engineering.

Option #2A (see Attachment #2, Kaiser cost data) evaluated moving the 1720-DR tank into the 300 Area, placing it north of the 3718-M building (see Figure 6, point B) and performing the heating and draining similar to the 100-DR location. The decreased cost (estimated at \$ 129K less) to drain the tank in the 300 Area is largely due to the rail line being at Class 1 standard and the shorter distance of panelized rail track required to move in the rail tanker (see Figure 6, point A). The cost estimate for completing option #2A is estimated at \$ 287.7K.

Option #2B is a modified version of option #2A but placing the tank by an active rail spur thus removing the need to lay panelized track. This option places the 1720-DR tank behind the 336 building (see Figure 6, point C) within 15 feet of the active rail line. The area is also surrounded by a fence with a 20 foot gate for easy access. At the site location presently sits the Transient Test Loop (TTL) block wall and concrete supports of the removed propane storage tank (see Figure 7). This unused TTL equipment is planned for removal during FY 1997. A portion of the block wall could be left as a support for the building and tank metal-liner. Selecting this 300 Area option to drain the 1720-DR tank will save the cost of laying the panelized track and remove three Kaiser work activities for an estimated cost savings of \$ 63.7K over option #2A. The cost estimate for completing option #2B is \$ 224.0K.

Since cost data was not factored into this report for Westinghouse EPA and FSTF Engineering project time, no credit was taken for lost time doing the draining at the remote 100-DR location. Travel time to and from the work site at the 100-DR location is over one hour a day. This coupled with craft/contractor and construction travel time, may decrease the work day accomplishments thus stretching out schedules and increasing costs. Also difficult will be the coordination of other N.E. Legacy Program work being conducted simultaneously in the 300 Area.

3.0 DESCRIPTION/COST DATA OF OPTIONS

3.1 OPTION #1

Option #1, draining the 1720-DR tank in place, evaluated cost data from 12 Kaiser work activities and seven Westinghouse controlled work activities. The seven Westinghouse controlled work activities were:

1. The walk-down and upgrade of the spur line to Class 1 standards from the main line to inside the 100-DR fence.	\$ 95.0K
2. Panelized rail track (about 675 feet) delivery, installation, ballasting, surfacing and removal at project end.	\$ 77.9K

FIGURE 1

NOTE: THIS MAP IS TO BE USED FOR
REFERENCE PURPOSES ONLY.
DO NOT USE THIS MAP
FOR CONSTRUCTION PURPOSES.

ICF Kaiser Portland Company
Mapping Services

DATE 4/8/04
REV. 9-26-95
DRAWN BY RAFAEL TORRES

FILE
300 AREA
CARTON 100 CENTER

Transient Test Loop (TTL) Removal

R2509016

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3. Fabricate sodium transfer line for tank to rail car transfer.	\$ 75.0K
4. Conduct ground penetrating radar (GPR) at tank car site.	\$ 1.5K
5. Provide radiation monitor services during track installation and removal.	\$ 4.0K
6. Design sodium transfer line.	\$ 15.0K
7. Move in, spot and remove rail tanker car.	\$ 7.2K
subtotal:	\$ 275.6K

The 12 Kaiser work activities are detailed in Attachment 1. The total cost estimate for the Kaiser work scope, including a 30% contingency:

subtotal: \$ 141.1K

Option #1 tank drain.....total: \$ 416.7K

3.2 OPTION #2A

Option #2A cost basis is much less with the elimination of the rail line upgrade and decreased cost for laying panelized rail track. This option moves the 1720-DR tank, liner and building into the 300 Area north of the 3718-M building, delivers the tanker car to the NW corner of the 3718-M building from the main rail spur on about 400 feet of panelized track and transfers the sodium into the tanker car. If work concerns arise about the panelized track across the road, the temporary track may have to be removed until the tank drain is complete and relaid thus increasing the estimated \$ 47.2K cost by as much as double to remove the rail tanker. This option consists of 15 Kaiser work activities and six Westinghouse controlled work activities. The six Westinghouse controlled activities are:

1. Panelized track (about 400 feet) delivery, installation, ballasting, surfacing and removal at the end of the project.	\$ 47.2K
2. Ground penetrating radar of site tanker car will set.	\$ 0.8K
3. Move in and spot rail tanker.	\$ 1.8K
4. Prepare Safety Evaluation for Packaging to transport tank into 300 Area.	\$ 15.0K
5. Fabricate sodium transfer line.	\$ 75.0K
6. Design sodium transfer line.	\$ 15.0K
subtotal:	\$ 154.8K

The 15 Kaiser work activities are detailed in Attachment 2. The total cost estimate for the Kaiser work scope, including a 30% contingency:

subtotal: \$ 132.9K

Option #2A tank drain.....total: \$ 287.7K

3.3 OPTION #2B (PREFERRED OPTION)

Option #2B is a modification to option #2A and removes the need to lay panelized track and also deletes three Kaiser work activities. This option involves removing items #1 and #2 under option #2A, removing the unused TTL equipment at the NE corner behind 336 building (argon tank, argon tank pad and propane tank enclosure - scheduled for removal during FY 1997), placing the rail tanker outside the 336 building fence on the adjacent Class #1 rated rail line and setting the 1720 DR tank, liner and building inside the fence about 15 feet from the rail line. This option consists of only 12 Kaiser work activities (deletes all fence and Conex box removal activities) and four Westinghouse controlled work activities. The Westinghouse controlled activities and costs are:

1. Move in and spot rail tanker. \$ 1.8K
2. Prepare Safety Evaluation for Packaging to transport tank into the 300 Area. \$ 15.0K
3. Design sodium transfer line. \$ 15.0K
4. Fabricate sodium transfer line. \$ 75.0K

subtotal: \$ 106.8K

The 12 Kaiser work activities will include all those listed in Attachment 2 except items 1, 3 and 4 and the 30% contingency for those items. The total cost for the Kaiser work activities is:

subtotal: \$ 117.2K

Option #2B tank drain.....total: \$ 224.0K

4.0 RECOMMENDATIONS AND CONCLUSIONS

4.1 RECOMMENDATIONS

Four recommendations will be made that have the potential to decrease the cost of the 1720-DR tank drain, maintain program coordination and provide input for a defensible Hazards Assessments if the tank is drained at 1720-DR or in the 300 Area.

1. An effort should be made to remove on schedule the old propane storage tank enclosure and the argon supply tank/pads that fed the TTL system which is located behind the 336 building in the 300

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Area. If this area behind 336 building is cleared, the 1720-DR building and tank could be set within 15 feet of the active rail line. No panelized track would need to be laid across the road south to 3718-M building and no 337 building work or PNL work need be jeopardized. This would save an estimated additional \$ 63.7K from the 300 Area option #2A tank drain and place option #2B costs at \$ 224.0K.

2. The N.E. Legacy Field Office is located in 335 building. If the 1720-DR tank and building were placed in the 300 Area for draining (at the location cited in recommendation #1 or beside the 3718-M building), coordination of all N.E. Legacy Program activities are now all within a one minute walk of each other. This allows for the cognizant project engineers to always be in close communication with one another. Answers can be given immediately, meetings can easily be called and held in the field office, problems resolved and full coordination of the program aspects easily maintained. This convenience of having all work co-located will help greatly to decrease costs and maintain schedule.

3. The draft Hazards Assessments for the sodium storage facilities located at 100-DR and the 300 Area need to be provided with accurate information by knowledgeable individuals that now work in the N.E. Legacy Program. The assessments and the emergency planning they support need to be accurate in the depiction and safety features constituted in the sodium storage facilities and the equipment storing the sodium. A review of the Hazards Assessments should be undertaken by knowledgeable N.E. Legacy personnel to provide the storage facility and equipment safety features and assure document consistency with other sodium storage facilities at FFTF and the Central Waste Complex (CWC).

4. An evaluation of the NEPA requirements, should the 1720-DR tank be moved into the 300 Area for draining, will be required.

5. If for some reason option #2A is chosen as the preferred tank drain option by the Project, a Site Evaluation needs to be submitted to see if leaving the panelized track across the road for several weeks, or longer, will raise work or safety concerns by WHC or other contractors. If the panelized track needs to be taken up and relaid, the cost estimate of \$ 47.2K needs to be doubled.

6. Due to program conflicts, the 337 building was not considered as a tank drain option. Program activities in the 337 building should be monitored to determine if space may become available to move in the 1720-DR tank and the rail tanker as another 300 Area tank drain option location. The north side of the facility is fed by an active rail spur making movement by rail in or out of the facility very easy. The facility will also provide weather cover for all draining operations removing the need to erect the 1720-DR building around the 1720-DR tank, saving additional costs. After draining the 1720-DR tank, rinsing of the tank in the 337 building should also be evaluated to reduce costs of moving the tank to the 335 building.

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4.2 CONCLUSIONS

The evaluation of the options presented in this report to drain the sodium from the 1720-DR tank are drawn not only from the cost savings incentives of one option over the other but also from the increased program coordination derived from one option.

1. There is a cost saving incentive to ship the 1720-DR tank into the 300 Area to drain the tank. The 300 Area options show estimated cost savings from 31% less (option 2A) to 46% less (option 2B) than tank drain at 10C-DR.

2. A substantial cost saving incentive exists if the area behind 336 building (planned TTL removal scope) is cleared on schedule during FY 1997 for placement of the 1720-DR building and tank. This action will support selection of the 300 Area preferred tank drain option saving an estimated \$ 192.7K over the 10C-DR option.

3. The rinsing of the 1720-DR tank in the 300 Area at the 335 building is much preferred. The building will be empty of sodium equipment and provide ample space for collecting rinsate, provide cover and is presently acting as a satellite accumulation area for N.E.Legacy sodium and NaK hazardous materials.

4. All material possible should be sent to salvage for resale as scrap. Efforts to locate buyers for the empty tank or the building should not be pursued if a buyer isn't evident.

5. The fabricated sodium transfer line should be capped and stored in 3718-M building for use when the 3718-M sodium tank is subsequently drained.

DISTRIBUTION SHEET

To	From	Page 1 of 1
Distribution	Packaging Engineering	Date Feb. 28, 1996
Project Title/Work Order		EDT No. 613312
Safety Evaluation for Packaging for the 1720-DR Sodium-Filled Tank (WPC-SD-TP-SEP-046)		ECN No. N/A

Name	MSIN	Text With All Attach.	Text Only	Attach./Appendix Only	EDT/ECN Only
J. A. Demiter	L5-31	X			
J. G. Field	G1-11	X			
C. R. Hocver	G1-11	X			
D. W. McHally	G1-11	X			
M. S. Mercado	G1-11	X			
S. S. Shiraga	G1-11	X			
Central Files	A3-88	X			
WPC-SD-TP-SEP-046 File	G1-11	X			