CH2M HILL ENGINEERING CHANGE NOTICE

Page 1 of 5

☒ DM ☐ FM ☐ TM

1a. **ECN** 721866 **R** 0

1b. **Proj. ECN** - - R

2. **Simple Modification** ☒ Yes ☐ No	3. **Design Inputs** – For full ECNs, record information on the ECN-1 Form (not required for Simple Modifications)		4. **Date** 06-08-04
5. **Originator's Name, Organization, MSIN, & Phone No.** NS Cannon, COGEMA Engineering, R1-82, 376-0562		6. **USQ Number** **No.** TF - - - R - ☒ **N/A** ☐ **Refer to Work Package**	7. **Related ECNs** NA
8. **Title** S-102 Initial Retrieval Functions and Requirements	9. **Bldg. / Facility No.** S-Farm	10. **Equipment / Component ID** NA	11. **Approval Designator** EQ
12. **Engineering Documents/Drawings to be Changed** (Incl. Sheet & Rev. Nos.) RPP-10901, Rev. 1B		13. **Safety Designation** ☐ SC ☐ SS ☐ GS ☒ N/A	14. **Expedited/Off-Shift ECN?** ☐ Yes ☒ No

15a. **Work Package Number** NA	15b. **Modification Work Completed** NA Responsible Engineer / Date	15c. **Restored to Original Status (TM)** NA Responsible Engineer / Date	16. **Fabrication Support ECN?** ☐ Yes ☒ No

17. **Description of the Change** (Use ECN Continuation pages as needed)

Problem: A new waste recirculation capability to allow the use of DST supernate for enhancing the efficiency of waste mobilization and dissolution for the S-102 Waste Retrieval System is to be designed and implemented. This DST supernate recirculation system has not been previously specified in the S-102 Initial Retrieval Functions and Requirements document RPP-10901.

Solution: Direct revision of RPP-10901, Rev. 1B, "S-102 Initial Retrieval Functions and Requirements" to produce RPP-10901, Rev. 1C. This new revision adds a paragraph to Section 4.8, "Waste Minimization" of RPP-10901, which provides the requirement for this recirculation capability. Supplemental information and changes are added to Section 3.3 and Section 5.4 to support the new recirculation requirement. Also, sentence added to Section 4.10 "Nuclear Safety" to support new DSA.

Analysis: N/A

Scope: Pages v, vi, and ix provide changes to the table of contents and acronym list; page 1-4 correction; page 3-17 gives Section 3.3 changes; page 4-4 provides Section 4.8 & 4.10 changes (pages 4-5 and 4-6 are also included as text is pushed by the insertion); and pages 5-11, 5-12 provide Section 5.4 changes (including Figure 5.3). Details of these changes are given on ECN pages 3 - 4. Section 7.0 references were added/deleted to update document as current on inserted pages 7-1 through 7-4.

18. **Justification of the Change** (Use ECN Continuation pages as needed)

Lessons learned from the S-112 retrieval to date include the observation that there was more low solubility waste in the tank than expected, which leads to significantly more dilute waste being introduced into the DST system than planned. S-102 is expected to have more low solubility waste than S-112. Recirculation of DST low saturation supernate to dissolve S-102 waste will reduce the eventual DST waste inventory significantly; additionally, several cross-site waste transfers and evaporator campaigns will be eliminated by this process. This reduction in the DST waste inventory, cross-site transfers, and evaporator operations will result in a large savings in schedule and cost. The S-102 F&R is modified to add the DST supernate solvent capability to the existing raw water capability requirements for the S-102 WRS.

USQ evaluation is not required (Block 6) as this document does not directly change field configuration or implement field operating requirements.

19. **ECN Category**

☒ **Direct Revision**
☐ **Supplemental**
☐ **Void/Cancel**

ECN Type

☐ **Supercedure**
☐ **Revision**

20. **Distribution**

Name	MSIN	Name	MSIN
See attached distribution list.			

Release Stamp

JUN 30 2004
DATE:
STA: 4
HANFORD RELEASE
ID: 21

CH2M HILL ENGINEERING CHANGE NOTICE

Page 2 of 5 ☒ DM ☐ FM ☐ TM

1a. **ECN** 721866 **R** 0

1b. **Proj. ECN** - - R

21. **Revisions Planned** (Include a brief description of the contents of each revision)
None

Note: All revisions shall have the approvals of the affected organizations as identified in block 11 "Approval Designator," on page 1 of this ECN.

22. **Design Basis Documents**
☒ Yes ☐ No

23. **Commercial Grade Item Dedication Numbers** (associated with this design change)
NA

24. **Engineering Data Transmittal Numbers** (associated with this design change, e.g., new drawings, new documents)
NA

25. **Other Non Engineering (not in HDCS)documents that need to be modified due to this change**

Type of Document	Document Number	Type of Document	Document Number
Retrieval Tank Operation Procedure	TO-410-905		

26. **Field Change Notice(s) Used?**
☐ Yes ☒ No
If Yes, Record Information on the ECN-2 Form, attach form(s), include a description of the interim resolution on ECN Page 1, block 17, and identify permanent changes.

NOTE: ECNs are required to record and approve all FCNs issued. If the FCNs have not changed the original design media then they are just incorporated into the design media via an ECN. If the FCN did change the original design media then the ECN will include the necessary engineering changes to the original design media.

27. **Design Verification Required?**
☐ Yes ☒ No
If Yes, as a minimum attach the one page checklist from TFC-ENG-DESIGN-P-17.

28. **Approvals**

Facility/Project Signatures		Date	A/E Signatures		Date
Design Authority	GP Janicek	6/28/04	Originator/Design Agent	NS Cannon	6-25-04
Resp. Engineer	JF Renholds	6/25/04	Professional Engineer		
Resp. Manager	WT Thompson	6/30/04	Project Engineer		
Quality Assurance	JF Bores	6/30/04	Quality Assurance		
IS&H Engineer	NA		Safety		
NS&L Engineer	RD Smith	6/29/04	Designer		
Environ. Engineer	JS Conrad	6/28/04	Environ. Engineer		
Engineering Checker	JF Renholds	6/25/04	Other		
Other	CE Hanson	6/28/04	Other		
Other	~~WB Barton~~ DA Reynolds	6/29/04	DEPARTMENT OF ENERGY / OFFICE OF RIVER PROTECTION		
Other	JJ Luke	6/29/04	Signature or a Control Number that tracks the Approval Signature		
Other	RE Bauer	6/29/04			
Other			ADDITIONAL SIGNATURES		
Other					
Other					

Document/Drawing No. RPP-10901 Sheet N/A Revision 1C

Change to Table of Contents per Page v:

4.11.1 DST Waste Temperature 4-45

4.11.2 DST Pressure Limits 4-45

Change to Table of Contents per Page vi:

4.12 OCCUPATIONAL SAFETY AND HEALTH 4-56

Change to Abbreviation and Acronym List per Page ix:

SRS	Supernate Recirculation System
TSR	Technical Safety Requirement
USQ	Unreviewd Safety Question

Change to Page 1-4: ...is categorized as a Flammable Gas ~~Facility~~ Group ~~2~~B tank (HNF-IP-1266) for ...

Change to Page 3-17:
Lessons learned prior to S-112 Retrieval startup have ~~already~~ provided some design and operational features that were ~~are being~~ given consideration for implementation in the retrieval effort system for Tank S-102. These features are highlighted in Appendix A.

One specific lesson learned after retrieving over 80 percent of S-112 has been that there was more low solubility waste than expected in the tank, which means significantly more dissolution raw water is required to complete tank retrieval than originally planned. This results in an extra waste inventory burden in the DST system. S-102 is expected to have more low solubility waste than S-112. A method to mitigate the generation of extra waste by recycling DST supernate as solvent for S-102 is specified in Section 4.8.

Change to Page 4-4:

4.8 WASTE MINIMIZATION

The Tank S-102 waste retrieval system shall minimize waste generation ~~to the greatest extent~~ where practical, including water introduced into the tanks and solid waste.

As a method for minimizing waste generation, the S-102 WRS shall include a system to draw SY Farm DST supernate for use as waste solvent in the S-102 retrieval process. This DST 'Supernate Recirculation System' (SRS) may be added to the S-102 WRS after S-102 Retrieval has been initiated (using raw water as the waste solvent). Recycling low saturation DST supernate for waste solvent allows more waste to be retrieved from S-102 with a minimal increase in DST waste volume (only the solids suspended or dissolved in the recirculated supernate will add to the DST waste volume). The SRS design shall allow either DST supernate or raw water to be used as the S-102 waste solvent. Instrumentation provided with the SRS shall be adequate to assure that there is no degradation in the uncertainty of the mass balance methods of leak detection, as described in Section 5.3.1.

Note: An AutoCAD page may be used in place of this form (the header section items must be included on the AutoCAD page).

4.10 NUCLEAR SAFETY

The Tank S-102 waste retrieval system shall be designed to protect workers, the public, the environment, and equipment from exposure to tank radioactive waste during retrieval in accordance with the Tank Farms Documented Safety Analysis (RPP-13033), the TSRs (HNF-SD-WM-TSR-006), and the Safety Basis USQ Procedure (TFC-ENG-SB-C-03) and Development Process (TFC-ENG-SB-C-06).

Note: Authorization for use of DST supernate for sluicing in an SST has not yet been approved by ORP. A Safety Basis amendment will be required prior to operations.

[Basis: 10 CFR 830 and 10 CFR 835]

4.11.1 DST Waste Temperature

The DST waste temperature shall not exceed:

- 250°F in all levels of the waste and concrete [Basis: OSD-T-151-00007], or
- 122°F in all level of waste if under JCO for SY-102 waste chemistry.

[Basis: JCO letter CH2M-0304014 (Aromi, 2003)]

NOTE: JCO expires 12 months after the start of the SY-102 out-of-specification period. Then AC 5.16 will be in affect.

Changes on Pages 5-11 and 5-12:

5.4 TANK S-102 SYSTEM DESCRIPTION

The retrieval and LDMM systems described in this section represent a view of the systems deployed, and ~~currently~~ planned for deployment, in Tank S-102. ~~Detailed design will enhance the definition of the system and may change the features described below. However,~~ Tthe final design shall comply with the requirements established in this document. Any subsequent changes will be established through the change control process described in Section 6.0.

5.4.1 WASTE RETRIEVAL SYSTEM

The S-102 Project will utilize three~~two~~ separate systems to dissolve and mobilize waste and remove it from the tank:

- **Water distribution system**: Water is introduced to the tank through four water distribution devices. The water distribution system has three directable nozzles in the three outer risers. The fourth distribution device is a modified tank washer nozzle that will be located 6 feet off center. The stream of the fourth nozzle is not directable once installed, but will be used to carve out a well around the central pump to ensure flow away from the tank wall and toward the pump.. The flow rate through the water distribution system can be varied and the flow monitored and recorded. The water is applied in a manner that will retrieve the waste from the "inside-out"; that is, the waste is first removed from the center of the tank to create a well or pit around the central pump (see Figure 5.3). This central well is

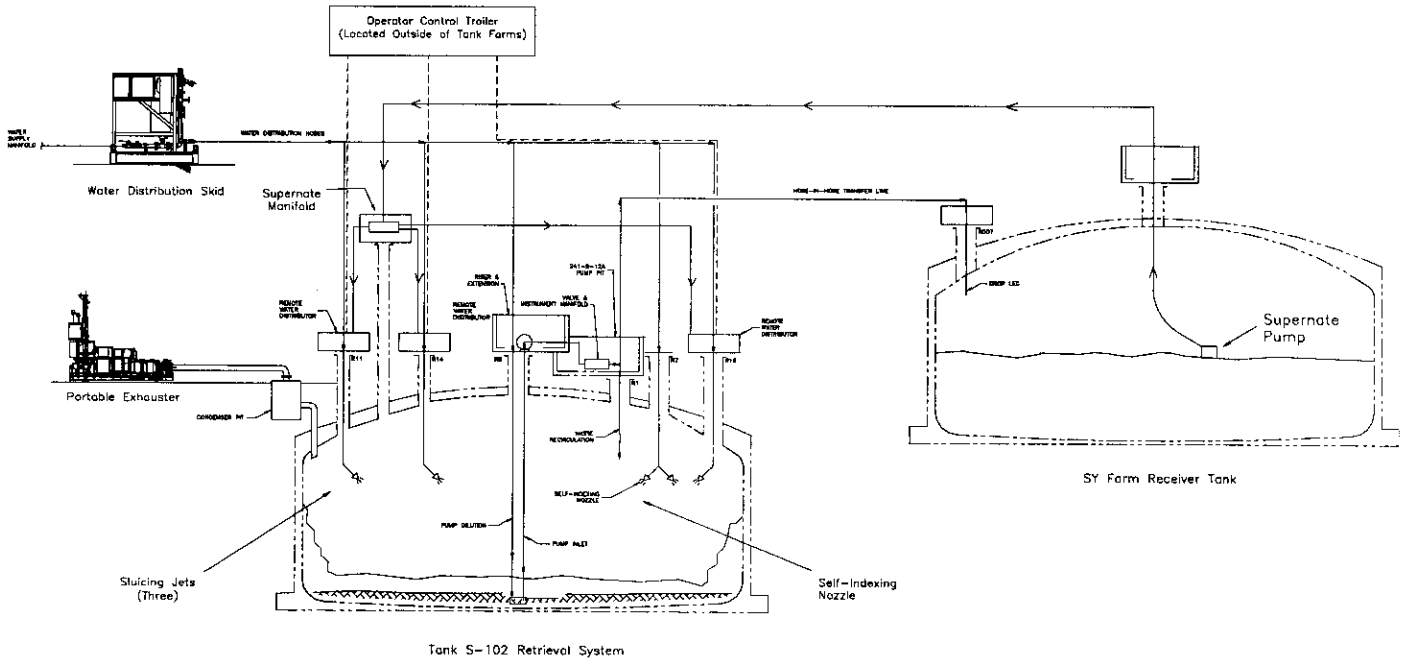
gradually enlarged until the tank wall is reached. At this point, the remaining waste is undermined to fall away from the wall. Finally, the remaining heel is removed to the extent practical.

- **Supernate distribution system**: Supernate from the SY Farm DSTs shall also be used to mobilize and dissolve S-102 waste. The components needed to recirculate supernate are generally illustrated in Figure 5.3, and general requirements are given in Section 4.8.
- **Waste solution removal system**: Waste is removed by a centrally located pump and pumped via a hose-in-hose transfer line to the SY tank farm. All transfer lines will be compliant with WAC 173-303. The pump has a capacity of approximately 90 gal/min to quickly pump down liquid inventory. Pump operation will be integrated with water addition to manage liquid level in the tank. The pump is located as close to the tank bottom as possible to maximize retrieval recovery. The hose-in-hose transfer line utilizes leak detectors to ensure line integrity. The pumping system can, if necessary, recirculate waste through a pipe routed through an open riser in the pump pit to reduce the total amount of water added by increasing contact time of the water with the waste.

Change to Figure 5-3, Page 5-12:

Figure 5.3. Proposed Tank S-102 Saltcake Waste Retrieval System

(not to scale)



Note: An AutoCAD page may be used in place of this form (the header section items must be included on the AutoCAD page).

DISTRIBUTION SHEET

To Distribution	From SST Projects	Page 1 of 1
Project Title/Work Order S-102 Initial Waste Retrieval Functions and Requirements, RPP-10901, Rev. 1C		**Date** June 2004 **EDT No.** NA **ECN No.** 721866 R0

Name	MSIN	Text With All Attach.	Text Only	Attach/ Appendix Only	EDT/ECN Only
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OFFICE OF RIVER PROTECTION					
R. W. LOBER	H6-60	X			
J. F. THOMPSON, JR	H6-60	X			

S-102 Initial Waste Retrieval Functions and Requirements

N. S. Cannon
COGEMA Engineering Corporation
Richland, WA 99352
U.S. Department of Energy Contract DE-AC27-99RL14047

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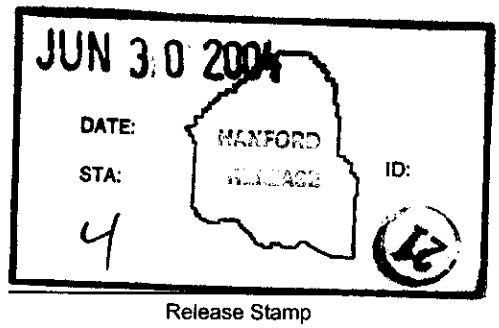
Abstract: N/A

6/30/04
Release Approval Date



Release Stamp

Approved For Public Release

RECORD OF REVISION

(1) Document Number: RPP-10901

(2) Title: S-102 Initial Waste Retrieval Functions and Requirements

Change Control Record

(3) Revision	(4) Description of Change - Replace, Add, and Delete Pages	Authorized for Release	
		(5) Cog. Engr.	(6) Cog. Mgr. Date
0	(7) Released per EDT 633273	D.W. Crass	M.H. Sturges
1	Revised per ECN 720281 R0	C.E. Hanson	W.T. Thompson
1A	Revised per ECN 721163 R0. Page revision to allow flexibility within the SY Farm receiver tanks.	C.E. Hanson	W.T. Thompson
1B	Revised per ECN 721656 R0. Page revision to redefine ILL and add HRR.	J.F. Renholds	W.T. Thompson
1C RS	Revised per ECN 721866 R0. Page revision to add DST supernate for waste solvent requirement.	J.F. Renholds 6/25/04	W.T. Thompson 6/10/04

CONTENTS

APPENDICES

ABBREVIATION AND ACRONYM LIST

BATEA	best available technology that is economically achievable
BBI	Best Basis Inventory
CFR	Code of Federal Regulations
COC	contaminants of concern
DOE	U.S. Department of Energy
DST	double-shell tank
Ecology	Washington State Department of Ecology
EPA	Environmental Protection Agency
F&R	functions and requirements
ILCR	Incremental Lifetime Cancer Risk
ILL	interstitial liquid level
LDMM	leak detection, monitoring, and mitigation
MOU	Memorandum of Understanding
NEPA	National Environmental Policy Act
NRC	Nuclear Regulatory Commission
ORP	Office of River Protection
RCRA	Resource Conservation and Recovery Act
REDOX	Reduction-Oxidation
RPE	Retrieval Performance Evaluation
RPP	River Protection Project
SRS	Supernate Recirculation System
SST	single-shell tank
TSR	Technical Safety Requirement
USQ	Unreviewed Safety Question
WAC	Washington Administrative Code
WDOE	Washington State Department of Ecology

volumes to be retrieved, the maximum volume that could be leaked during retrieval, and risk from residual waste based on known and estimated radionuclide contamination and contaminant migration within the vadose zone as the basis of calculation.

- Including a design and operating approach that takes into consideration a range of leak and residual waste volumes (Appendix B).
- Including lessons learned from previous DOE and industry retrieval projects (Appendix A).
- Including the LDMM and retrieval strategy for the Tank S-102 retrieval program (Section 5.0).
- Addressing mitigation strategies and decision thresholds for potential leaks during retrieval (Section 3.0).

The functions and requirements identified in this document provide the basis for the design criteria and design requirements documented in Project Level 2 specifications. Level 2 specifications are used to develop the project engineering concepts, scope, and boundaries. The content of the specifications will include detailed requirements such as operating pressures, temperatures, materials of construction and control system requirements, confinement boundaries and controls, interface requirements, and similar detailed application requirements. The specifications for the Tank S-102 retrieval system are currently in development and will be revised during preliminary and final design activities consistent with this approved functions and requirements document.

1.4 TANK S-102 CONDITIONS

Tank S-102 was constructed between 1950 and 1951. It is second in a cascade series of three tanks beginning with Tank S-101 and ending with Tank S-103. The tank is constructed with a painted grout layer, an asphalt (waterproof) membrane, and an outer reinforced concrete shell to maintain the structural integrity of the steel liner by protecting it from soil loads. The reinforced concrete shell is cylindrical with a domed roof. The interior of the tank contains a steel liner constructed of mild steel. The steel liner extends up the tank wall to a height of 7.6m (25 feet). It was constructed to support an operating volume of 750,000 gallons.

The tank currently contains approximately 447,000 gallons of saltcake and sludge waste, and is categorized as a Flammable Gas Group B tank (HNF-IP-1266) for hydrogen/flammable gas. The tank received waste from Reduction-Oxidation (REDOX) between 1953 and 1979. The tank received its waste from Tank S-101 via cascade operation. The REDOX waste was generated between 1952 and 1957. The tank received evaporator bottoms and recycled waste from the 242-S Evaporator from 1973 to 1976. The tank had a final transfer from it in 1992, after being labeled inactive in 1980. A large surface spill occurred in 1973 that contaminated the soil around Tanks S-102, and S-103. The gamma-ray-emitting radionuclides cobalt-60 (60Co) and cesium-137 (137Cs) were detected in the resulting plume. The majority of the contaminated soil at grade was removed and replaced with an indeterminate depth of clean soil overburden (ARH-2935,

3.3 LESSONS LEARNED SUPPORTING SELECTION AND DEPLOYMENT OF RETRIEVAL & LDMM TECHNOLOGIES

DOE and good engineering practice establish that lessons learned from previous activities to be documented and used in the design considerations for similar activities. This applies to tank waste retrieval and LDMM. Lessons learned from other similar projects provide valuable experience that is referred to during design activities and operation of the retrieval and LDMM system. Lessons learned do not form the functions and requirements for the retrieval and LDMM system design and execution. However they do influence, based on past experience and application, how the functions and requirements are achieved. During the various project phases (i.e., initial engineering development, preliminary design, detailed design, construction, and operations), lessons learned shall be identified and evaluated for application relevant to the Tank S-102 retrieval effort. This experience will guide the design team in the selection of the best retrieval and LDMM technologies.

Appendix A contains a description of the process used to gather lessons learned, the relevant lessons learned that apply to this project, and the bibliography of sources used in gathering the lessons learned information. The lessons learned topics include LDMM, retrieval, instrumentation, and operational experience from previous DOE and industry-related retrieval projects, as required by Milestone M-45-05-T03. DOE will incorporate these lessons learned during the design and operation of the Tank S-102 waste retrieval system. The best available and deployable, tank farms, LDMM technology will be used for Tank S-102 retrieval.

Lessons learned prior to S-112 Retrieval startup have provided some design and operational features that were given consideration for implementation in the retrieval effort system for Tank S-102. These features are highlighted in Appendix A.

One specific lesson learned after retrieving over 80 percent of S-112 has been that there was more low solubility waste than expected in the tank, which means significantly more dissolution raw water is required to complete tank retrieval than originally planned. This results in an extra waste inventory burden in the DST system. S-102 is expected to have more low solubility waste than S-112. A method to mitigate the generation of extra waste by recycling DST supernate as solvent for S-102 is specified in Section 4.8.

4.8 WASTE MINIMIZATION

The Tank S-102 waste retrieval system shall minimize waste generation where practical, including water introduced into the tanks and solid waste.

As a method for minimizing waste generation, the S-102 WRS shall include a system to draw SY Farm DST supernate for use as waste solvent in the S-102 retrieval process. This DST 'Supernate Recirculation System' (SRS) may be added to the S-102 WRS after S-102 Retrieval has been initiated (using raw water as the waste solvent). Recycling low saturation DST supernate for waste solvent allows more waste to be retrieved from S-102 with a minimal increase in DST waste volume (only the solids suspended or dissolved in the recirculated supernate will add to the DST waste volume). The SRS design shall allow either DST supernate or raw water to be used as the S-102 waste solvent. Instrumentation provided with the SRS shall be adequate to assure that there is no degradation in the uncertainty of the mass balance methods of leak detection, as described in Section 5.3.1.

4.9 MITIGATE LEAKS DURING TANK S-102 WASTE RETRIEVAL PROCESS

The integrated retrieval and LDMM system shall be designed and operated to mitigate leak volumes ranging from 8,000 gallons to 40,000 gallons for the duration of the retrieval demonstration. The Tank S-102 waste retrieval system shall mitigate leaks as the primary means of minimizing environmental impact caused by releases during retrieval of SST waste. If a leak occurs, the release shall be evaluated according to the RPE and the appropriate actions implemented (e.g., continue or discontinue retrieval). As the primary mitigation means, the retrieval pump shall be designed to allow continuous pumping for a sufficient amount of time (to be determined during design) to remove all pumpable liquids from Tank S-102. An operational approach that minimizes the free liquid in the tank shall be employed for waste retrieval, ensuring that the interstitial liquid level remains below its starting level (see Figure 5-6). The interstitial liquid level prior to the beginning of salt well pumping (March 1999, tank non-leaking) was approximately 17.2 feet (206 inches). Mitigation activities will be consistent with the intent of HNF-SD-WM-AP-005, *SST Leak Emergency Pumping Guide*.

[Basis: HNF-SD-WM-AP-005 (CHG 1999).]

4.10 NUCLEAR SAFETY

The Tank S-102 waste retrieval system shall be designed to protect workers, the public, the environment, and equipment from exposure to tank radioactive waste during retrieval in accordance with the Tank Farms Documented Safety Analysis (RPP-13033), the TSRs (HNF-SD-WM-TSR-006), and the Safety Basis USQ Procedure (TFC-ENG-SB-C-03) and Development Process (TFC-ENG-SB-C-06).

Note: Authorization for use of DST supernate for sluicing in an SST has not yet been approved by ORP. A Safety Basis amendment will be required prior to operations.

[Basis: 10 CFR 830 and 10 CFR 835]

4.11 DST DESIGN LIMITS

The Tank S-102 waste retrieval system shall not adversely affect the function of the DST System or exceed the DST Design and operational limits. The DST design and operational limits are as follows:

4.11.1 DST Waste Temperature

The DST waste temperature shall not exceed:

- 250°F in all levels of the waste and concrete [Basis: OSD-T-151-00007], or
- 122°F in all levels of waste if under JCO for SY-102 waste chemistry.

  [Basis: JCO letter CH2M-0304014 (Aromi, 2003)]

NOTE: JCO expires 12 months after the start of the SY-102 out-of-specification period. Then AC 5.16 will be in affect.

4.11.2 DST Pressure Limits

The Tank S-102 waste retrieval system shall not cause the following internal DST pressure limits to be exceeded:

Primary Tanks:

- -15.2 cm (6 in.) water gauge (w.g.) ≤vapor space pressure ≤-0.76 cm (0.3 in.) w.g. during normal operating conditions and ≤0 during required maintenance or off-normal conditions (AN, AW, AY, AZ, SY Farms)
- -24.1 cm (9.5 in.) w.g. ≤vapor space pressure ≤-0.76 cm (0.3 in.) w.g. during normal operating conditions and ≤0 during required maintenance or off-normal conditions (AP-Farm)

  [Basis: HNF-3350, CHG 2000c]

4.11.3 DST Hydrostatic Load Limits

The Tank S-102 waste retrieval system shall not cause the internal DST hydrostatic loads limits specified in Table 4-1 to be exceeded.

Table 4-1: Existing Double-Shell Tank Hydrostatic Load Limits

Tank Farm	Hydrostatic Load
AN, AW	Maximum hydrostatic load as exerted by 4410 m^3 (1.16 Mgal) of fluid @ 1.7 SpG and a depth of 10.7 m (422 in.)
AP	Maximum hydrostatic load as exerted by 4410 m^3 (1.16 Mgal) of fluid @ 2.0 SpG and a depth of 10.7 m (422 in.)
AY, AZ	Maximum hydrostatic load as exerted by 3790 m^3 (0.998 Mgal) of fluid @ 1.22 SpG. and a depth of 9.25 m (364 in.)
SY	Maximum hydrostatic load as exerted by 4330 m^3 (1.14 Mgal) of fluid @ 1.7 SpG and a depth of 10.7 m (422 in.)

[Basis: HNF-3350, CHG 2000c]

The Tank S-102 waste retrieval system new components shall be designed to ensure proper structural strength, compatibility with the waste and protection against corrosion in accordance with requirements of 40 CFR 265.192 and WAC 173-303-640(3).

- The retrieval system design shall be constructed of modular and easily replaceable subsystem components if economically advantageous.

  [Basis DOE Order 430.1A, DOE 1998]

- The retrieval system shall be designed for reuse if economically advantageous.

  [Basis DOE Order 430.1A, DOE 1998]

4.12 OCCUPATIONAL SAFETY AND HEALTH

The Tank S-102 waste retrieval system shall incorporate design features that comply with the applicable requirements of 29 CFR 1910.

[Basis: 29 CFR 1910]

4.13 SST AND DST DOME LOADING

The Tank S-102 waste retrieval system shall not exceed the maximum dome loading on existing SSTs and DSTs specified in HNF-IP-1266, 5.14, Rev. 2.

[Basis: RPP-13033]

4.14 PROHIBITED MATERIALS.

Materials that are restricted or prohibited from use in manufacturing, operation, and construction under regulations promulgated pursuant to 40 CFR Subchapter R, shall not be used in the design of the Tank S-102 waste retrieval system.

[Basis: 40 CFR Subchapter R]

4.15 WASTE RETRIEVAL SYSTEM SECONDARY CONTAINMENT AND LEAK DETECTION

The Tank S-102 waste retrieval system shall incorporate in new components secondary containment and leak-detection design features in accordance with 40 CFR 265.193 and WAC 173-303-640.

[Basis: 40 CFR 265 and WAC 173-303]

4.16 WASTE RETRIEVAL SYSTEM DEACTIVATION AND DECONTAMINATION

The Tank S-102 waste retrieval system equipment deactivation shall be compatible with decontamination, reuse and/or disposal requirements, e.g., disposal as solid waste.

[Basis: DOE G 430.1-3, DOE 1999a]

Table 5-4. Summary Statistical Results for Ex-Tank Leak Detection Response Time (including large leaks)

Parameter	10-foot Distance (f = 0.75)	45-foot Distance (f = 0.50)
Mean travel time	20 d	1,200 d (3.3 y)
Median travel time	2.2 d	130 d
5th percentile time	0.07 d	4.1 d
95th percentile time	72 d	4,400 d (12 y)
Mean volume leaked	100 gal	6,200 gal
Median volume leaked	73 gal	4,400 gal
5th percentile volume	20 gal	1,200 gal
95th percentile volume	300 gal	18,000 gal

Notes: The mean value is the sum of the times or volumes divided by the number of trials. The median value is the time or volume is the 50th percentile in the cumulative distribution (i.e., half the results lie below the median value). The 5th and 95th percentiles show the range of times or volumes that encompass 90% of the calculated results.

5.4 TANK S-102 SYSTEM DESCRIPTION

The retrieval and LDMM systems described in this section represent a view of the systems deployed, and planned for deployment, in Tank S-102. The final design shall comply with the requirements established in this document. Any subsequent changes will be established through the change control process described in Section 6.0.

5.4.1 WASTE RETRIEVAL SYSTEM

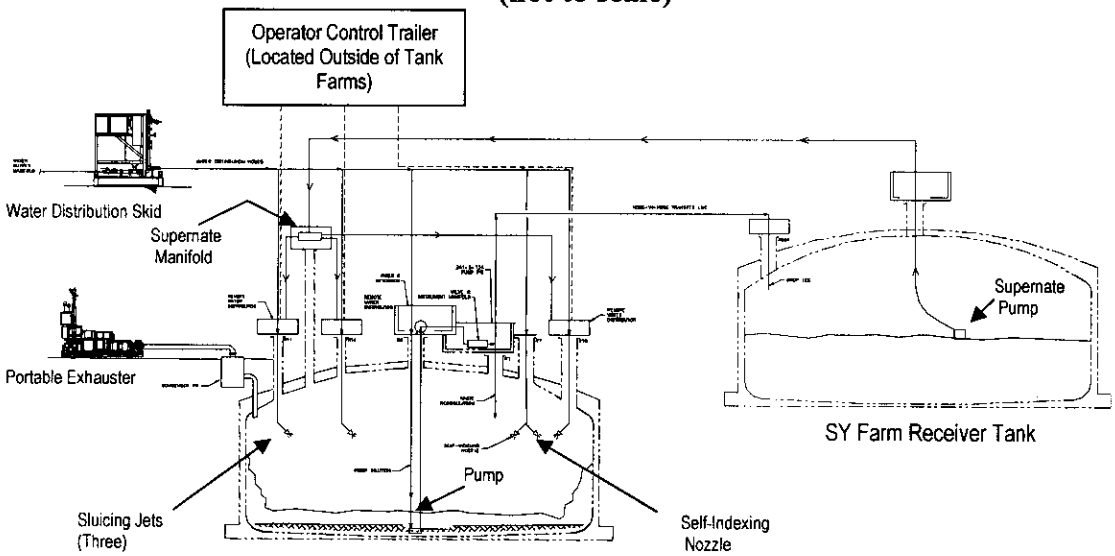
The S-102 Project will utilize three separate systems to dissolve and mobilize waste and remove it from the tank:

- **Water distribution system**: Water is introduced to the tank through four water distribution devices. The water distribution system has three directable nozzles in the three outer risers. The fourth distribution device is a modified tank washer nozzle that will be located 6 feet off center. The stream of the fourth nozzle is not directable once installed, but will be used to carve out a well around the central pump to ensure flow away from the tank wall and toward the pump. The flow rate through the water distribution system can be varied and the flow monitored and recorded. The water is applied in a manner that will retrieve the waste from the "inside-out"; that is, the waste is first removed from the center of the tank to create a well or pit around the central pump (see Figure 5.3). This central well is gradually enlarged until the tank

wall is reached. At this point, the remaining waste is undermined to fall away from the wall. Finally, the remaining heel is removed to the extent practical.

- **Supernate distribution system**: Supernate from the SY Farm DSTs shall also be used to mobilize and dissolve S-102 waste. The components needed to recirculate supernate are generally illustrated in Figure 5.3, and general requirements are given in Section 4.8.
- **Waste solution removal system**: Waste is removed by a centrally located pump and pumped via a hose-in-hose transfer line to the SY tank farm. All transfer lines will be compliant with WAC 173-303. The pump has a capacity of approximately 90 gal/min to quickly pump down liquid inventory. Pump operation will be integrated with water addition to manage liquid level in the tank. The pump is located as close to the tank bottom as possible to maximize retrieval recovery. The hose-in-hose transfer line utilizes leak detectors to ensure line integrity. The pumping system can, if necessary, recirculate waste through a pipe routed through an open riser in the pump pit to reduce the total amount of water added by increasing contact time of the water with the waste.

Figure 5.3. Proposed Tank S-102 Saltcake Waste Retrieval System (not to scale)



5.4.2 LEAK DETECTION AND LEAK MONITORING SYSTEM DESCRIPTION

The baseline method for leak detection and leak monitoring involves periodic gamma and neutron moisture surveys of the drywells surrounding the tank. This will be supplemented by static liquid level monitoring of a pumped down pool performed between waste retrieval campaigns or at other times when retrieval operations are shut down and there is sufficient time to perform the static test. Less accurate in-tank process control parameters will be observed throughout the waste retrieval campaign to supplement the ex-tank drywell and in-tank static level methods and provide a defense-in-depth approach to identify indications of potential "gross" leaks. The following sections describe the equipment used for these

7.0 REFERENCES

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