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Technical Evaluation for Negative Tank Pressure at Closure Facilities

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U.S. Department of Energy Contract DE-AC27-99RL14047

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Abstract:
This document contains the technical evaluations that were performed to ensure the actively ventilated closure facilities would not be damaged by negative pressures. This includes a summary of the problem and the technical evaluations subsequently provided.

7/28/04

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Technical Evaluations for Negative Tank Pressure at Closure Facilities

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List of Terms

CFM	Cubic Feet per Minute
DCRT	Double Contained Receiver Tanks
DP	Differential Pressure
DST	Double Shell Tank
ETR	Engineering Test Report
wg	Inches Water Gauge
OAT	Operational Acceptance Testing
OE	Operability Evaluation
OSD	Operating Specification Document
SST	Single Shell Tank
TE	Technical Evaluation

1.0 INTRODUCTION

During a DOE-HQ assessment of vapor concerns in SX/SY tank farms on March 13, 2004 a question was raised, "For single shell tanks with active ventilation, what specific analysis and/or controls are in place to prevent over pressurization or under pressurization to assure the operating specification document(OSD) limits for Differential pressure(DP) in tank from structural protection is met?" This led to formal finding, known as C-9 which stated, "Double shell tanks(DST) and single shell tanks(SST) with active exhaust ventilation systems at the River Protection Project Tank Farms are not provided with adequate vacuum relief devices or other vacuum protection measures, such as positive administrative controls on critical valves, to preclude potential excessive vacuum conditions that could seriously damage the tanks." A series of Operability and Technical Evaluations were subsequently provided as part of the corrective actions to determine the technical condition of the tank farms.

1.1 PURPOSE

The purpose of this document is to formally document the findings of the Operability/Technical Evaluations written to satisfy corrective action C-09-18 and C-09-19. These corrective actions called for Technical Evaluations to be performed to ensure that adequate positive/negative pressure relief is provided for Retrieval Systems/Tanks and for all other SST Tank Farm Contractor facilities with actively-ventilated tanks that are subject to potential high pressure or vacuum conditions. This includes a summary of the findings of these evaluations and technical recommendations.

1.2 SCOPE

This document and the Technical Evaluations included as attachments cover the scope of all SST Tank Farm Facilities with Active Ventilation and retrieval systems that are subject to potential high pressure or vacuum conditions. This includes the facilities using permanent ventilation systems, the portable exhauster systems, and the retrieval systems. The facilities with permanent ventilation include the 241-SX Tank Farm and the Double Contained Receiver Tanks(DCRT) 244-BX, 244-S, 244-TX, 244-AR, and 244-CR. The portable exhauster system covers POR03, POR04, POR05, POR06, and POR-008, and all SSTs that are ventilated by the portable exhausters. The retrieval system that applies to this document is the C-200 vacuum pump system currently in use at C-201, C-202, C-203, and C-204.

2.0 EVALUATION

2.1 TECHNICAL RECOMMENDATION

The conclusion of the attached evaluations is that all closure project active ventilation systems can be operated within the allowed OSD limits for tank vacuum. More detailed information for the separate systems can be found below and in attachments A through E.

The Portable exhauster systems are considered OPERABLE as shown in the Data Summary table (Appendix A), the portable exhausters currently in service (POR-008, POR03, and POR04) can be operated within the allowable OSD limits for the tanks they are deployed on (C-106, C-200, and S-112 respectively). The combination of technologies currently used to control vacuum has proven effective for maintaining the tank vacuum levels. Variations in tank pressure due to the retrieval process (hot water sprays, etc) have been found to cause temporary pressure spikes (not pressure drops). This results in the tank vacuum decreasing temporarily, until the system stabilizes. It is expected that this will continue to be the case for future retrieval activities. There are no expected conditions within the retrieval process that would cause the tank vacuum level to spike in the other direction (increasing vacuum).

The SX Ventilation System is considered OPERABLE because of the combination of technologies currently used to control vacuum at SX Farm has proven effective for maintaining safe design tank vacuum levels. A worst case scenario was considered in Attachment B. The worst case scenario for vacuum control considered one SX Farm tank in service with one exhaust fan on-line. In the unlikely event that all exhaust dampers are closed at all tanks with the exception of one tank, there is insufficient vacuum available to cause structural damage with the operating exhauster. The combination includes balancing airflow using inlet dampers, outlet dampers at the exhaust duct from the tank and vaneaxial dampers at the fan using administrative controls.

The technical evaluation for the C-200 Vacuum Retrieval system determined that the system is OPERABLE as shown in attachment C of this document. The system was designed to prevent the tank vacuum from exceeding the requirements in OSD-T-151-00013.

The evaluation for the Double Contained Receiver Tanks (DCRT) 244-S, 244-BX, 244-TX, located at appendix E of this document, determined that in the worst case scenario no resulting structural damage would result.

The 244-AR and 244-CR vault ventilation system is the only other ventilation system used in the recent past for the closure project facilities. This system is currently inactive and has been de-energized putting it out of operation. This system was not evaluated for the reasons stated in attachment D of this document.

Improbable events such as intentional malicious acts, or highly improbable equipment malfunctions were not considered as contributors to tank vacuum changes.

Therefore the conclusion of this evaluation is that all retrieval project ventilation systems discussed in this evaluation can be operated within the allowed OSD limits for tank vacuum.

3.0 REFERENCES

DOE Letter 02-TED-019, *Contract No. DEAC27-99RL14047 – Deferral of a Safety Basis (SD)*
Amendment to Close the Justification for Continued Operation (JCO) of 241-SX Tank Farm Without Active Ventilation, January 7, 2003.

HNF-SD-WM-CN-116, Rev.0-A, *Calculation Notes Hydrogen Generation*

HNF-SD-WM-TSR-006, Rev 3, *Tank Farms Technical Safety Requirements.*

OSD-T-151-00013, Rev.E-6, *Operating Specification for Single Shell Waste Storage Tanks*

RPP-7420, Rev. 1, *MRS Performance Specification*

RPP-10435, Rev.0, *Single Shell Tank System Integrity Assessment Report*

RPP-11051, Rev. 0-A, *Technical Basis Document for Single-Shell Tank Operating Specifications*

RPP-11413, Rev. 2, *Technical Basis for Ventilation Requirements in Operating Spec.Documents*

RPP-11788, Rev. 0, *Single Shell Tank Waste Retrieval Allowable Vacuum Assessment*

RPP-11829, Rev 1, *Federal Facility Compliance Agreement: Stack Isolation Project Functions and Requirements.*

RPP-12051, Rev 0, *244-AR Vault Interim Stabilization Completion Report.*

RPP-14075, Rev. 1A, *WRS Level 2 Specification, Section 3.2.1.2*

RPP-15479, Rev. 0A, *Generic Functional Requirements and Technical Design Criteria for Portable Exhausters POR03, POR04, POR05, POR06 and POR-008*

RPP-16666, Rev. 0, *HIHTL Integrity Assessment/OTP*

RPP-16667, Rev. 0A, *Vendor Acceptance Test Report for HIHTL*

RPP-16945, Rev. 4, *Process Control Plan, control 3.2.1 "Tank Pressure"*

RPP-17190, Rev. 1, *Safety Evaluation of the C-200 Retrieval System*

RPP-17742, Rev. 3, *Technical Basis for Vacuum Exhaust Line Rupture Representative Accident*

SD-RE-TI-035, Rev.1, *Technical Bases for Single-Shell Tank Operating Specifications*

WAC 246-247-080(6), *Radiation Protection/Air emission/Inspections, reporting, and recordkeeping.*

APPENDIX A

Operability Evaluation for Portable Exhauster Operation on Single Shell Tanks

~~ORIGINAL~~ COPY

NUMBER: OE-04-01 **DATE/TIME OF REQUEST:** NA

TITLE: Operability/Technical Evaluation for Retrieval/Closure Portable Exhauster Operation on Single Shell Tanks

REVISION: 1

PER NUMBER: PER-2004-1710

OCCURRENCE REPORT: N/A

EQUIPMENT IDENTIFICATION NUMBER: POR03, POR04, POR05, POR06, POR-008

DEGRADED OR NONCONFORMING CONDITION:

This discussion provides a justification for allowing continued operation of portable ventilation systems to support retrieval activities for C-106, C-200, S-112, and S-102 and future near term retrieval projects.

The specific question being addressed by this justification was posed by DOE-HQ assessment team on March 13, 2004 during a walk down of SX/SY farm related to tank farm vapor concerns.

> "For SSTs with active ventilation, what specific analysis and/or controls are in place to prevent over pressurization or under pressurization (e.g. prevent vacuum in tank) – to assure the OSD limits for DP in tank from structural protection is met."

This evaluation will be focused on showing if portable ventilation systems can be operated on single shell tanks within the allowable limits. Although this evaluation is primarily focused on the operation of portable exhausters, in reality the degraded condition in question is the deterioration of the single shell tanks structural integrity over time, and whether this degraded state is capable of withstanding the forces generated by the operation of portable ventilation systems used in support of retrieval activities.

REFERENCE DOCUMENTS:

OSD-T-151-00013, *Operating Specification for Single Shell Waste Storage Tanks*
RPP-11051, *Technical Basis Document for Single-Shell Tank Operating Specifications*
RPP-11788, *Single Shell Tank Waste Retrieval Allowable Vacuum Assessment*
SD-RE-TI-035, *Technical Bases for Single-Shell Tank Operating Specifications.*
RPP-15479, "*Generic Functional Requirements and Technical Design Criteria for Portable Exhausters POR03, POR04, POR05, POR06 and POR-008*"

AFFECTED SYSTEM(S):

The affected systems covered by this evaluation are: portable exhausters, POR03, POR04, POR05, POR06, and POR-008, and all Single Shell Tanks (SSTs) that are ventilated by the portable exhausters.

DESIGN REQUIREMENTS:

The Operating Specification Document for SSTs is OSD-T-151-00013 with supporting basis document RPP-11051, *Technical Basis Document for Single-Shell Tank Operating Specifications.* The OSD basis for the SST vacuum limits is RPP-11788, *Single Shell Tank Waste Retrieval*

Allowable Vacuum Assessment. RPP-11788 provides allowable vacuum limits to guard against bottom uplift or buckling of the steel liner during waste retrieval activities as the waste level is reduced. This document does not specifically evaluate the ultimate capacity of the concrete tank structure against vacuum loading since the vacuum limits on the ¼-inch thick steel liner for bottom uplift are more restrictive as the tank is emptied. When there is sufficient waste in the tank to counteract this vacuum pressure loading, the previous OSD maximum vacuum limit of 9 in. water gauge (w.g.) was retained as a precautionary measure to control the loading on the concrete structure based on a previous vacuum limit of 15 in. w.g. given in SD-RE-TI-035, *Technical Bases for Single-Shell Tank Operating Specifications.*

It should also be noted that the existing revision of RPP-11788 (Rev 0) addresses the potential for the tank wall to buckle. The conservative "worst case" estimated for corrosion in this revision suggest a need for tank vacuum limits that are more restrictive than those specified in OSD-013. The mode of failure is the separation of the steel tank liner from the concrete tank wall. Further evaluation of the data in this RPP-11788, Rev 0 (by the document author L Julyk) has revealed that the document is overly conservative. The attached E-mail (Attachment 2) documents the need for a revision to RPP-11788 to reduce the level of conservativeness. These revised values do in fact support the limits contained in OSD-013. Therefore, complying with the limits in the OSD will ensure the revised limits in RPP-11788 are not exceeded.

The steel tank liners of the SSTs were designed to the following design standards (RPP-10435, 2002, *Single-Shell Tank System Integrity Assessment Report*):

Tanks	Design Standard
B, C, T, U, BX, TX, and SX	Standard Specification for Elevated Steel Water Tanks, Standpipes and Reservoirs per American Waterworks Association (AWWA)
BY, S, TY, A, and AX	ASME Section VIII Para. U-68 (1946)

REGULATORY COMMITMENTS:

Portable exhausters are installed for retrieval projects to maintain a vacuum on the waste tanks to minimize the potential for "fugitive emissions" from the tank during waste disturbing operations that would otherwise result in a positive pressure and force contamination out through unfiltered/uncontrolled intrusions into the tank. The use of portable exhausters is specifically required in the Notice of Construction (NOC) for each of the retrieval projects for this purpose. From a fugitive emissions control stand point, the greater the vacuum in the tank the better, to allow a greater buffer to offset pressure spikes caused by retrieval activities. The established design requirement for a minimum vacuum of 0.3 in w.g. during normal operating conditions, and is defined in RPP-15479, "Generic Functional Requirements and Technical Design Criteria for Portable Exhausters POR03, POR04, POR05, POR06 and POR-008", Section 4.2.2.1.

Conversely, restricting tank vacuum level is necessary in order to comply with the tank Operating Specifications (*Operating Specifications for Single-Shell Waste Storage Tanks,* OSD-T-151-00013), which specify a maximum vacuum limit dependent on waste height. Note that for tank 241-C-106, which is a dish-bottom tank, waste height is defined as an average waste height. The maximum vacuum limit for the 241-C tanks = ((waste height x specific gravity) + 0.8 in. w.g.), not to exceed 9 in. w.g. In an empty tank, this means that the maximum vacuum limit is 0.8 in. w.g.. The vacuum limits protect the tank steel liner from potential bottom uplift, which could lead to a tear in the liner, providing a leak path for the waste. When there is sufficient waste in the tank to counteract the vacuum pressure to prevent tank bottom uplift, a maximum vacuum of 9 in. w.g. is imposed as a precautionary measure to control the loading on the concrete structure based on a previous vacuum limit of 15 in. w.g. given in SD-RE-TI-035, *Technical Bases for Single-Shell*

Tank Operating Specifications. In an empty tank, every 1 in. w.g. of vacuum could produce an upward pressure on the tank bottom liner of approximately 5.2 lb/ft^2 or 0.036 lb/in^2 (normally this pressure is offset by the waste hydrostatic pressure and the weight of the tank liner itself).

With these two competing requirements the allowable vacuum range can become quite small. Therefore it is necessary to balance tank vacuum level using various techniques.

SAFETY FUNCTION(S):

The portable exhausters are all classified as General Service equipment by the Safety Equipment List (RPP-8792, Revision 7). Therefore there is no formally defined "safety function" for portable exhausters defined by the Documented Safety Analysis (DSA) or Technical Safety Requirements (TSRs).

However the portable exhausters do provide a environmental protection function that is analogous to a safety function, and that is to minimize/prevent the release of uncontrolled fugitive emissions from waste tanks during the waste retrieval process.

EFFECT ON HARDWARE:

Historically, maximum tank vacuum limits identified in the OSD-013 have not been an issue because the tanks contain sufficient waste levels and tank ventilation systems are generally not capable of producing enough vacuum in the tank, due to excessive air in-leakage through cascade lines, cracks, pits, and various other tank intrusions. But it has been difficult to maintain the required minimum vacuum levels to minimize fugitive emissions. Most SSTs have excessive in leakage making it difficult to pull a vacuum in excess of 0.5 in. w.g.. To maintain even minimal tank vacuum it has been necessary to seal all visible tank intrusions with tape/foam and to close off the isolation valves on Breather filters. It also requires that inlet stations flow path be restricted by the use of mechanical vacuum controllers, or manual throttling of isolation valves. However, when waste retrieval efforts got underway, it became necessary to look more closely at the decreasing OSD allowable vacuum levels resulting from lower waste levels. The reduced allowable vacuum levels that result from waste removal from the tanks required the use of various technologies/methods/controls to maintain the tank vacuum within the allowable limits. The following is a summary of these vacuum control techniques.

Vacuum limiting techniques used for Retrieval

The available methods used to limit tank vacuum from exceeding the established OSD limits are discussed below:

Breather filter Seal loops - These are installed on SSTs to provide vacuum/pressure relief (of a nominal 4-6 in w.g.. They are designed as a pressure relief in the event of over/under pressurization and must be refilled once the seal is broken in order to restore containment. The flow capability of the seal loop is not rated to the full capacity of the portable exhausters, but will provide a partial relief.

Inlet HEPA Filters – Inlet HEPA filters are installed on all tanks where the permanent Breather filters do not have a rated flow capacity to match the potential flow rate of exhauster being used on the given tank. The purpose of the inlet filter is to provide a source of air in-leakage with sufficient capacity to offset the air being withdrawn from the tank by the exhauster. Typical pressure drops for clean HEPA filters are around 0.5 in w.g. at the rated flow. The pressure drop will increase as the filters collect particulate material.

Air in-leakage - Air in-leakage from cascade lines, cracks, pit openings, and various other tank intrusions, result in a significant source of air flow into the tanks. As an example at S-112 when portable exhauster POR-4 was running at a nominal 450 cfm, the measured in flow at the inlet station was approximately 100 cfm. This means that the other 350 cfm (78% of total flow) was entering into the tank from the other various in-leakage paths.

Exhauster controls – The computer control function of the portable exhausters is used to shut down the exhauster in the case of excessive vacuum levels (may be measured at the tank riser or on the exhauster ducting depending on the system). While this method can provide a vacuum-limiting function, it is not very practical if the allowable range of tank vacuum is small (e.g., -0.3 to -0.8 in. w.g.).. Relatively small fluctuations in tank pressure induced by the dynamic retrieval operation would routinely result in exhauster shut down, which would then result in an increase in fugitive emissions. Therefore, the set points on this interlock is set between 3.0 and 4.5 in w.g. (varies with exhauster). This is primarily intended as a conservative protection for the higher limits specified in the OSD For example the when the waste tanks have more than a few inches of waste. (Note: that for those systems where the vent duct pressure is used, this value will indicate a slightly greater vacuum level that what is actually in the tank due to pressure drops in the ducting. This results in conservative offset in the reading when excessive vacuum is of concern.)

Procedural controls: During exhauster operation rounds are taken (at least twice daily) on the tank pressure or vent duct pressure to ensure than excessive tank pressure is within the allowable range. (Note: that for those systems where the vent duct pressure is used, this value will indicate a slightly greater vacuum level that what is actually in the tank due to pressure drops in the ducting. This results in conservative offset in the reading when excessive vacuum is of concern)

Vacuum <u>increasing</u> techniques used for Retrieval

The available methods used to increasing tank vacuum and to minimize fugitive emissions are discussed below:

Tape/foam – Adding sealing tape/ or foam to tank intrusions will result in the potential for increased vacuum levels in the tank by reducing air in-leakage paths. Conversely, removal of tape/foam will increase air in-leakage potential and therefore result in a decreased potential for elevated tank vacuum levels. During waste retrieval activities (e.g., sluicing), the pits are generally sealed with tape as best as possible, to minimize the potential for fugitive emissions, both radiological and chemical.

Manual valve/damper - Installing a manual inlet valve/damper (or using an existing air inlet isolation valve if available) can be used to increase the vacuum level in a tank by restricting air flow into that tank. This has proven necessary to achieve the minimum required vacuum level in S-112, where the isolation valve on the inlet station has been closed completely just to maintain minimal vacuum levels (0.3 to 0.5 in w.g.)

Mechanical vacuum controller (deployed for C-100 series retrieval activities) - The design (drawing H-14-105646) is a variation of the "floating orifice" flow control design previously tested and installed in AW and AN tank farms. It is a simple mechanical design, requiring no electrical components or control instrumentation. It has one moving part, no bearings, and no significant wear surfaces. It can be adjusted while on-line, responds immediately to changes in pressure. The device is essentially a self adjusting "restriction" in the inlet filter flow path. It can be set to provide additional resistance in the air flow path for various values, ranging from as little as 0.3 in. w.g. and can be adjusted in nominal 0.5 in. w.g. increments up to approximately 4 in. w.g. Although this device is good for maintaining vacuum at a consistent level, and minimizing fugitive emissions potential by off setting pressure variations induced by the retrieval process, it does not act as a safety relief. It provides additional restriction for air flow into the tank above what it would exist if the device was not present.

Procedural controls: During exhauster operation rounds are taken (at least twice daily) on the tank pressure or vent duct pressure to ensure that excessive tank pressure is within the allowable range and does not exceed the allowable limits.

TECHNICAL RECOMMENDATION:

The Portable exhausters are considered OPERABLE for use on single shell tanks. As shown in the Data Summary table (Attachment 1), the portable exhausters currently in service (POR-008, POR03, and POR04) can be operated within the allowable OSD limits for the tanks they are deployed on (C-106, C-200, and S-112 respectively). The combination of technologies currently used to control vacuum has proven effective for maintaining the tank vacuum levels. Variations in tank pressure due to the retrieval process (hot water sprays, etc) have been found to cause temporary pressure spikes (not pressure drops). This results in the tank vacuum decreasing temporarily, until the system stabilizes. It is expected that this will continue to be the case for future retrieval activities. There are no expected conditions within the retrieval process that would cause the tank vacuum level to spike in the other direction (increasing vacuum). Improbable events such as intentional malicious acts, or highly improbable equipment malfunctions are not considered as expected or anticipated initiators of excessive vacuum spikes.

POR03: The high vacuum interlock for POR03 (C-200) is set conservatively to 4.5 in w.g. and is below the worst case (empty tank) OSD limit of 5.3 in w.g..

POR04: The high vacuum interlock for POR04 (S-112) is set to 3.0 in w.g and is well within the current OSD vacuum limit of 9.0 w.g. Although this is not set conservatively below the worst case (empty tank) OSD limit of 2.0 in w.g., it is still considered acceptable for use based on the significant amounts of waste remaining in the tank. The vacuum levels experienced to date (nominal 0.5 in w.g.) are well within the OSD (empty tank) limit of 2.0 in w.g. and the current OSD vacuum limit of 9.0 w.g. Additionally, the Process Control Plan (PCP) RPP-15085, for S-112 requires that the exhauster be shut down when the waste level in the tank drops to approximately 5.5". This requirement is incorporated into the S-112 retrieval procedure. This waste level corresponds to a calculated OSD vacuum of approximately 9 in w.g., which ensures the exhauster set point of 3.0 in w.g. protects the OSD vacuum limit for the tank. To minimize confusion, ECNs have been initiated to lower the interlock set point for POR04 (S-112) to match the worst case (empty tank) OSD limit of 2.0 in w.g.

POR-008: The high vacuum interlock for POR08 (C-106) is set to 4.5 in w.g. Although this is not set conservatively below the worst case (empty tank) OSD limit of 0.8 in w.g., it is still considered acceptable for use because the vacuum levels experienced to date (nominal 0.5 w.g.) are within the OSD (empty tank) limit of 0.8. Also, the current calculated OSD limit is 3.3 in w.g., based on residual waste still remaining in the tank which helps to offset the potential for increasing the vacuum in the tank to lift the bottom. The set point value of 4.5 in w.g. allows for the expected pressure drop that occurs in the ventilation ducting between the tank and the location of the pressure transmitter.

POR05 is currently undergoing Operational Acceptance Testing prior to retrieval activities on S-102, and is isolated from the tank. Continuance of the OAT will not impact tank vacuum levels in any manner until the final stages of the test. When the OAT requires operation of the exhausters on the tank, the inlet filter will be open and have a clean HEPA filter installed. The inlet filter assembly isolation valve will be fully open and is expected, based on historical information, to have an approximate maximum pressure drop of 0.5 in w.g., assuming no in-leakage from any other source. Therefore the start up of this ventilation system can be achieved within the OSD limits (9.0 in w.g.).

Due to similarities in design, tank age, and exhauster sizing, and retrieval technologies it is anticipated that S-102 will experience very similar vacuum levels to those experienced on S-112 (nominally 0.3 to 0.5 in w.g.). If vacuum levels in excess of 0.3 in w.g. are not achievable with the inlet filter completely open (as was the case at S-112), it will be necessary to tape/foam tank intrusions and/or slowly throttle the inlet filter isolation valve until the tank vacuum exceeds 0.3 in w.g. so that fugitive emissions can be minimized.

POR05: The high vacuum interlock for POR05 (S-102) is set to 3.0 in w.g and is well within the current OSD vacuum limit of 9.0 w.g. Although this is not set conservatively below the worst case (empty tank) OSD limit of 2.0 in w.g., it is still considered acceptable for use based on the significant amounts of waste remaining in the tank and similar operational history with S-112. The vacuum levels experienced to date on S-112 (nominal 0.5 in w.g.) are well within the OSD (empty tank) limit of 2.0 in w.g. and the current OSD vacuum limit of 9.0 w.g. Additionally, the draft Process Control Plan (PCP) for S-102 requires that the exhauster be shut down when the waste level in the tank drops to approximately 6". This waste level corresponds to a calculated OSD vacuum of approximately 9 in w.g., which ensures the exhauster set point of 3.0 in w.g. protects the OSD vacuum limit for the tank. To minimize confusion, ECNs have been initiated to lower the interlock set point for POR04 (S-102) to match the worst case (empty tank) OSD limit of 2.0 in w.g.

A similar logic can be applied to upcoming retrieval activities in C-103 and C-105 which will utilize exhauster POR-008 connected to C-103, C-105, and C-106 using a common manifold with isolation valves for the individual tanks. The anticipated vacuum levels in C-103 and C-105 should closely mirror what has been experienced during retrieval of C-106. Prior to startup of retrieval activities on C-103 and C-105 an evaluation will be performed to determine if individual pressure transmitters are desirable on the 3 tanks (C-103, C-105, and C-106) that will be connected to POR-008. The installation of additional pressure transmitters will likely require additional upgrades and PLC logic changes to the exhauster to accommodate the new signal inputs and associated alarm displays

Therefore the conclusion of this evaluation is that all retrieval project ventilation systems discussed in this evaluation can be operated within the allowed OSD limits for tank vacuum.

COMPENSATORY MEASURES:

None.

Evaluator: TR FARRIS [signature] Date: 4-6-04

Reviewer: [signature] SS Swaney Date: 4/6/2K4

Responsible Engineering Manager [signature] for M. Sutey G. H. Jansen Date: 4/7/04

~~Waste Feed Operations~~ CLOSURE PROJECTS Shift Operations Manager Receipt: Date: 4/7/2004

Time: 0800

4/7/04 DJS ~~Waste Feed Operations~~ CLOSURE PROJECTS Shift Operations Manager: DJ SAUERESSIG

Operations Review:

Operations declares the system: ☒ OPERABLE ☐ Not OPERABLE

Comments:

DJS 4/7/2004 ~~Waste Feed Operations~~ CLOSURE PROJECTS Shift Operations Manager: [signature]

Date: 4/7/2004

Time: 1030

Attachment 2
(E-mail)

Attachment 1
Data Summary

Tank Farm (SSTs)	System	Fan Design Capacity		Design Basis Vacuum[1]	OSD vacuum limit for empty tank "A" Vacuum[2]	Tank Volume[3]	Calculated Hydrostatic Head[4]	Current OSD Vacuum limit[5]	Typical Vacuum Reading[6]	Interlock Set point	Seal loop installed on Breather Filter?	Comments
		Flow (cfm)	SP (in w.g.)	(in. w.g.)	(in. w.g.)	in.	(in. w.g.)	(in. w.g.)	(in. w.g.)	(in. w.g.)		
C-200	POR-03	500	11	-15	5.3	2.5	3.5	8.8	0.3 to 0.7	4.5	Yes	250 cfm breather filters used as inlet filter (2 tanks ventilated at any given time)
S-112	POR-04	500	11	-15	2	223.3	314.6	9.0	0.3 to 0.5	3	Yes	Inlet valve is closed now;
S-102	POR-05	500	11	-15	2	159.3	225.0	9.0	future	3	Yes	close valve as needed to achieve vacuum
AR-vault	POR-06	500	N/A	-15	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Out of Service, isolated from vault and power disconnected
C-106	POR-08	1,000	12.24	-15	0.8	1.8	2.5	3.3	0.5 - 1	4.5	Yes	
C-103 (future)	POR-08	1,000	12.24	-15	0.8	25.8	36.9	9.0	future	4.5	Yes	Tank not ducted to exhauster.
C-105 (future)	POR-08	1,000	12.24	-15	0.8	48.0	68.0	9.0	future	4.5	Yes	Tank not ducted to exhauster.

Notes:
1. Reference: SD-RE-TI-035, "Technical Bases for Single-Shell Tank Operating Specifications"
2. Reference: RPP-11788, Rev. 0, Table 0. Allowable Vacuum for Empty Single-Shell Tanks
3. Reference: Waste Tank Summary Data 12/31/03.
4. Calculated hydrostatic head using formula in OSD-T-151-00013, Rev. E-6, Operating Specification for Single Shell Waste Storage Tanks, with an assumed specific gravity of 1.4.
5. Current OSD limit: "A" plus waste height (inches) times specific gravity (assumed to be 1.4) of waste (assumed 1.4) or 9 in w.g. whichever is lower. Reference: RPP-11788, Rev. 0, Table 0. Allowable Vacuum for Empty Single-Shell Tanks (worst case condition is either the calculated hydrostatic head plus the limit for an empty tank, or 9 in. w.g.).
6. Reference: Round Sheet data.

Message

Farris, Troy R

From: Julyk, Larry J

Sent: Monday, March 29, 2004 2:32 PM

To: DeFigh-Price, Cherri; Sutey, Michael J

Cc: Schlosser, Richard L; Farris, Troy R; Koch, Michael R; Julyk, Larry J; Mackey, Thomas C; Fish, Michael A; Lowe, David C; Payne, Lois

Subject: RE: Vacuum limits response TRF.doc

Importance: High

Cherri and Mike,

The design specifications for the DSTs required that the steel primary tanks and liners be designed in accordance with ASME Section VIII, Div. 2, Alternate Rules for Pressure Vessels. The design specification defines the extent to which the above Code shall be applied together with supplemental information necessary for the specification application. It was the intent of the design specification that the design of the tanks be consistent with the basic design and analysis techniques established in the Code, but the specification did not intend to have the design certified for subsequent licensing and code stamping of the tanks.

The steel tank liners of the SSTs were designed to the following design standards (RPP-10435, 2002, *Single-Shell Tank System Integrity Assessment Report*):

Tanks	Design Standard
B, C, T, U, BX, TX, and SX	Standard Specification for Elevated Steel Water Tanks, Standpipes and Reservoirs per American Waterworks Association (AWWA)
BY, S, TY, A, and AX	ASME Section VIII Para. U-68 (1946)

The concrete structures of the SSTs were designed to resist all internal and external loads. The steel liners provide a protective layer on the concrete inner surface to prevent direct contact of the stored waste with the concrete and thus prevent leakage of the waste to the surrounding soil. That is, the steel liners are generally considered non-structural components.

In addition, Mo Anantatmula has provided revised corrosion estimates for the SST steel liners that he believes are more realistic (see attached email). I have recalculated the RPP-11788 allowable vacuum to prevent bottom uplift and sidewall buckling using Mo's revised corrosion estimates (see attached spreadsheet). The allowable vacuum against sidewall buckling is greater than 9 inches water gauge (w.g.) in all cases out to a 2028 retrieval date. This is consistent with the current OSD-T-151-00013 maximum vacuum requirement of 9-in. w.g. when there is sufficient residual waste to prevent bottom uplift of the steel liner. The allowable vacuum against bottom uplift for an empty tank also increased for the revised corrosion estimates. The allowable maximum vacuum against bottom uplift or buckling for an empty tank went from 0.8 to 1.6 in. w.g.

Hence, the argument that the steel liner sidewall would not likely buckle under vacuum because the pressure would likely be equalized on either side of the liner if sidewall buckling imitated is no longer needed. This argument hinged on the assumption that the lead flashing at the top of the liner and the asphaltic membrane waterproofing between the liner and the concrete for some SSTs did not provide an air tight seal after approximately 40 to 50 years of exposure to high temperatures from the stored waste. The lead flashing was provided to prevent waste overfill or condensate on the dome from running down and getting between the steel liner and the concrete wall.

So, how do we want to proceed from here, please advise..............

Larry

4/1/2004

REV 1 3/28/2004

Allowable Vacuum for Single-Shell Tanks

Tank Farm	Steel Liner Bottom Allowable Vacuum: Nominal wall thk (in.)	Corrosion loss at 2004 (min/max) (mils)	Bottom spherical cap: Radius R_s (in.)	Bottom spherical cap: Rise H_s (in.)	Wall thk at 2028 (max/min) (in.)	Buckling parameters: Classical buckling P_{cl} (in. w.g.)	Buckling parameters: Shallowness λ	Buckling parameters: Knockdown factor α	Self weight pressure P_w (in. w.g.)	Waste SpG	Bottom allowable vacuum (in. w.g.), Average waste height h_{avg} (in.): 0	1	2	3	4	Steel Liner Sidewall Allowable Vacuum (for information only): Wall location	Nominal wall thk (in.)	Corrosion loss at 2004 (min/max) (mils)	Cylinder radius R_{cyl} (in.)	Length between stiffeners L_s (in.)	Wall thk at 2028 (max/min) (in.)	Buckling parameters: M_x	Buckling parameters: C_w	Sidewall allowable vacuum (in. w.g.)
100-Series Single-Shell Tanks																								
B	0.25	14	68.40	12	0.264	1.51	17.35	0.151	2.07	1	2.17	3.17	4.17	5.17	6.17	Lower	0.25	14	450	54	0.264	4.96	0.243	24.37
		34			0.201	0.77	19.85	0.148	1.58		1.64	2.64	3.64	4.64	5.64			34			0.201	5.68	0.204	11.94
										1.25	2.17	3.42	4.67	5.92	7.17	Upper	0.25	11			0.267	4.93	0.245	25.11
											1.64	2.89	4.14	5.39	6.64			51			0.184	5.91	0.193	9.47
C	0.25	14	68.40	12	0.264	1.51	17.35	0.151	2.07	1	2.17	3.17	4.17	5.17	6.17	Lower	0.25	14	450	54	0.264	4.96	0.243	24.37
		34			0.201	0.77	19.85	0.148	1.58		1.64	2.64	3.64	4.64	5.64			34			0.201	5.68	0.204	11.94
										1.25	2.17	3.42	4.67	5.92	7.17	Upper	0.25	11			0.267	4.93	0.245	25.11
											1.64	2.89	4.14	5.39	6.64			51			0.184	5.91	0.193	9.47
T	0.25	14	68.40	12	0.264	1.51	17.35	0.151	2.07	1	2.17	3.17	4.17	5.17	6.17	Lower	0.25	14	450	54	0.264	4.96	0.243	24.37
		34			0.201	0.77	19.85	0.148	1.58		1.64	2.64	3.64	4.64	5.64			34			0.201	5.68	0.204	11.94
										1.25	2.17	3.42	4.67	5.92	7.17	Upper	0.25	11			0.267	4.93	0.245	25.11
											1.64	2.89	4.14	5.39	6.64			51			0.184	5.91	0.193	9.47
U	0.25	14	68.40	12	0.264	1.51	17.35	0.151	2.07	1	2.17	3.17	4.17	5.17	6.17	Lower	0.25	14	450	54	0.264	4.96	0.243	24.37
		34			0.201	0.77	19.85	0.148	1.58		1.64	2.64	3.64	4.64	5.64			34			0.201	5.68	0.204	11.94
										1.25	2.17	3.42	4.67	5.92	7.17	Upper	0.25	11			0.267	4.93	0.245	25.11
											1.64	2.89	4.14	5.39	6.64			51			0.184	5.91	0.193	9.47
BX	0.375	11	68.40	12	0.396	2.67	14.27	0.156	3.06	1	3.26	4.26	5.26	6.26	7.26	Lower	0.25	13	450	54	0.265	4.95	0.243	24.62
		41			0.327	2.04	15.57	0.153	2.37		2.72	3.72	4.72	5.72	6.72			33			0.202	5.66	0.205	12.49
										1.25	3.26	4.51	5.76	7.01	8.26	Upper	0.25	11			0.267	4.93	0.245	25.11
											2.72	3.97	5.22	6.47	7.72			49			0.186	5.90	0.195	9.74
TX	0.375	11	68.40	12	0.396	2.67	14.27	0.156	3.06	1	3.26	4.26	5.26	6.26	7.26	Lower	0.3125	13	450	54	0.327	4.45	0.280	43.33
		31			0.327	2.04	15.57	0.153	2.37		2.72	3.72	4.72	5.72	6.72			33			0.265	4.95	0.244	24.64
										1.25	3.26	4.51	5.76	7.01	8.26	Upper	0.25	11			0.267	4.93	0.245	25.11
											2.72	3.97	5.22	6.47	7.72			49			0.186	5.90	0.195	9.74
BY	0.375	13	68.40	12	0.396	2.67	14.27	0.156	3.06	1	3.26	4.26	5.26	6.26	7.26	Lower	0.3125	13	450	54	0.327	4.45	0.280	43.33
		41			0.327	2.04	15.57	0.153	2.37		2.72	3.72	4.72	5.72	6.72			33			0.265	4.95	0.244	24.64
										1.25	3.26	4.51	5.76	7.01	8.26	Upper	0.25	11			0.267	4.93	0.245	25.11
											2.72	3.97	5.22	6.47	7.72			48			0.187	5.88	0.195	9.80
S	0.375	13	68.40	12	0.396	2.67	14.27	0.156	3.06	1	3.26	4.26	5.26	6.26	7.26	Lower	0.3125	13	450	54	0.327	4.45	0.280	43.33
		32			0.326	2.04	15.55	0.153	2.36		2.73	3.73	4.73	5.73	6.73			32			0.266	4.94	0.244	24.89
										1.25	3.26	4.51	5.76	7.01	8.26	Upper	0.25	11			0.267	4.93	0.245	25.11
											2.73	3.98	5.23	6.48	7.73			47			0.188	5.87	0.196	10.02
TY	0.375	13	68.40	12	0.396	2.67	14.27	0.156	3.06	1	3.26	4.26	5.26	6.26	7.26	Lower	0.3125	13	450	54	0.327	4.45	0.280	43.33
		32			0.326	2.04	15.55	0.153	2.36		2.73	3.73	4.73	5.73	6.73			32			0.266	4.94	0.244	24.89
										1.25	3.26	4.51	5.76	7.01	8.26	Upper	0.25	10			0.268	4.92	0.245	25.36
											2.73	3.98	5.23	6.48	7.73			46			0.189	5.85	0.196	10.16
SX	0.375	13	68.40	14.875	0.396	2.67	15.89	0.155	3.06	1	3.28	4.28	5.28	6.28	7.28	Lower	0.375	13	450	54	0.390	4.08	0.316	69.34
		31			0.329	2.05	17.26	0.151	2.59		2.74	3.74	4.74	5.74	6.74			31			0.329	4.41	0.282	44.06
										1.25	3.28	4.53	5.78	7.03	8.28	Upper	0.375	10			0.393	4.06	0.318	70.79
											2.74	3.99	5.24	6.49	7.74			45			0.315	4.53	0.275	39.24
A	0.375	13	Flat	0	0.390	0	0	0	3.06	1	3.06	4.06	5.06	6.06	7.06	Lower	0.375	13	450	54	0.390	4.08	0.316	69.34
		31			0.329	0	0	0	2.59		2.59	3.59	4.59	5.59	6.59			31			0.329	4.41	0.282	44.06
										1.25	3.06	4.31	5.56	6.81	8.06	Upper	0.375	10			0.393	4.06	0.318	70.79
											2.59	3.84	5.09	6.34	7.59			45			0.315	4.53	0.275	39.24
AX	0.375	12	Flat	0	0.391	0	0	0	3.07	1	3.07	4.07	5.07	6.07	7.07	Lower	0.375	12	450	54	0.391	4.07	0.317	69.82
		28			0.332	0	0	0	2.61		2.61	3.61	4.61	5.61	6.61			28			0.332	4.42	0.284	45.16
										1.25	3.07	4.32	5.57	6.82	8.07	Upper	0.375	10			0.393	4.06	0.318	70.79
											2.61	3.86	5.11	6.36	7.61			39			0.321	4.49	0.277	41.27
200-Series Single-Shell Tanks																								
B, C, T, U	0.25	14	44.1	6	0.264	140.73	12.27	0.161	2.07	1	13.42	14.42	15.42	16.42	17.42	Lower	0.25	14	120	270	0.264	48.01	0.020	27.72
		34			0.201	81.77	14.01	0.156	1.58		7.98	8.98	9.98	10.98	11.98			34			0.201	54.95	0.017	14.06
										1.25	13.42	14.67	15.92	17.17	18.42	Upper	0.25	11			0.267	47.74	0.020	28.52
											7.98	9.23	10.48	11.73	12.98			51			0.184	57.43	0.016	11.27

Mill Tolerance (mils)		Corrosion rate (mils/yr) from year 2004	
min	-10	min	0.1
max	30	max	0.2

γ_{water}	0.0361	lb/in^3
in. w.g.	0.0361	psi
γ_{steel}	0.284	lb/in^3
E	26,400,000	psi
ν	0.3	

C	1.652	$[3(1-\nu^2)]^{0.5}$
FS	2	Factor of safety on buckling
	2028	Retrieval year
	2004	

Farris, Troy R

From: Larry [larryjulyk@charter.net]
Sent: Sunday, March 28, 2004 3:06 AM
To: Larry_J_Julyk@rl.gov
Subject: FW: Revised SST Wall Thinning estimates report

From: r p anantatmula [mailto:anantafam@usamedia.tv]
Sent: Saturday, March 27, 2004 3:18 PM
To: Larry
Subject: Re: Revised SST Wall Thinning estimates report

Larry:

0.1 and 0.2 mpy. I have included text to reflect this in the table as well as the body of the attached report.

Mo.

> ----- Original Message -----
> **From:** Larry
> **To:** 'r p anantatmula'
> **Sent:** Saturday, March 27, 2004 2:31 PM
> **Subject:** RE: Revised SST Wall Thinning estimates report
>
> Mo,
> What corrosion rate do I use after 2004 for each region?
> Larry
>
> ---
>
> **From:** r p anantatmula [mailto:anantafam@usamedia.tv]
> **Sent:** Saturday, March 27, 2004 1:42 PM
> **To:** Larry_J_Julyk@rl.gov
> **Cc:** larryJulyk@charter.net; Michael_A_Fish@rl.gov
> **Subject:** Revised SST Wall Thinning estimates report
>
> Larry:
>
> I finally got it done. The maximum wall loss is 51 mils. If you have any questions, we can discuss those when I get back or you can call me on my cell phone on Monday or thereafter. My cell phone number is 509-438-1619.
>
> Have a nice week-end and a nice week.
>
> Mo.

WALL THINNING OF BOTTOM AND SIDEWALL BY GENERAL CORROSION FOR SINGLE-SHELL TANKS AT THE HANFORD SITE

INTRODUCTION

The majority of the wastes stored in the SSTs are radioactive slurries generated by irradiated uranium fuel reprocessing using the Bismuth-Phosphate process, the reduction oxidation (REDOX) process, the plutonium-uranium extraction (PUREX) process, the tributyl phosphate (TBP) process, and the B Plant waste fractionation process. All of the fuel processing methods generated acidic waste streams. Sodium hydroxide or calcium carbonate was added to the waste before the waste was transferred to the tanks to neutralize the acid and thus minimize tank corrosion. The tanks currently contain moderately to strongly alkaline solutions, with pH values exceeding 13.

According to Hanlon (2002), 67 Hanford SSTs have been declared confirmed or assumed leakers, so it is obvious that the liners of at least some of the tanks have been breached by some mechanism. Results of SST integrity examinations reported in RPP-10435, Rev. 0 show that pitting corrosion at the liquid-vapor interface corresponding to prior liquid levels appears to have perforated the liners of some tanks. A few tanks with self-boiling wastes have experienced bulges in the bottom of the liners. This is thought to be due to expansion of steam underneath the liner. The stresses induced by the bulges, in combination with pitting and stress corrosion cracking-induced liner degradation, are the mechanisms that may have resulted in breaches of the liners. On the other hand, photographs and videotapes of many SST liners show that the liners appear to be in very good condition from a general corrosion perspective. That is, there is very little visible evidence of significant general corrosion. Although general corrosion always occurs, it does not usually lead to failure of industrial systems. Ultrasonic inspection of tank wall and bottom of non-stress relieved tanks at SRS indicated very little general wall thinning in ten years of testing. Therefore, the breach of the 67 SSTs presumably occurred by either pitting or stress corrosion cracking (SCC) or a combination of both mechanisms.

This report includes an evaluation of thickness loss experienced by the bottom and sidewall of single-shell tanks (SSTs) from general corrosion during the period from the start of operations to year 2004. The basis of the evaluation and the results are described in detail in the following.

2.0 EVALUATION BASIS

The in-tank coupon data and laboratory-simulated waste data were used as a basis for evaluating the SST wall thickness loss from start of operations to year 2004. The in-tank general corrosion data in the liquid ranged from 0.1 to 0.8 mils/year (mpy), while the in-tank general corrosion data in the vapor space ranged from 0.05 to 2 mpy (Anantatmula

1994). The maximum general corrosion rate observed in simulated REDOX wastes in the laboratory was 3.1 mpy in a 1,000-hour exposure (Endow 1952).

For this evaluation, a minimum general corrosion rate of 0.1 mpy was assumed for the tank bottom and lower wall (contacting the waste) for all the SSTs based on the in-tank coupon data. The maximum general corrosion rate for the tank bottom and lower wall of the SSTs was derived from the maximum corrosion rate of 3.1 mpy observed in the laboratory test. Although general corrosion rate is high initially, the rate decreases with time because of the difficulty in the transport of oxygen to the metal surface through the oxide film. Because oxygen transport through the oxide layer to the metal surface is diffusion controlled, the weight loss is expected to follow a parabolic relationship with time leading to a decrease in corrosion rate with time.

Most SSTs have been operating for over 50 years. During this time period, the corrosion rate decreases quite rapidly and the average corrosion rate over the roughly 50-year period is calculated to be 0.3 mpy. The corrosion rate in the vapor space of the SSTs is assumed to be a factor of 2 higher than that of the steel wall contacting the waste. This was based on the corrosion probe coupon data (Anantatmula 2001) from tank 241-AN-107, where the humidity conditions in the dome space are expected to be somewhat similar to that for the SSTs.

Table 1 lists the estimates of general corrosion depth for all SSTs based on the discussion above. It is recommended to use 0.1 mpy for tank bottom and lower wall, and 0.2 mpy for upper wall for general corrosion rates beyond 2004.

TABLE 1
GENERAL CORROSION DEPTH ESTIMATES FOR SINGLE-SHELL TANKS

TANK FARM	CONSTRUC-TION DATE	UNIFORM CORROSION DEPTH TO 2004 (MILS)[a]			ASSUMPTIONS
		BOTTOM	LOWER WALL	UPPER WALL	
100 SERIES TANKS					Assumed a uniform corrosion damage depth of 8-17 mils during water storage (assumed to be 4 years duration) prior to start of operations for all tanks including the 200 series. Assumed a corrosion rate of 0.1-0.3 mpy for tank bottom and lower wall, and 0.05-0.6 mpy for the upper wall. The minimum values were obtained from previous laboratory tests in liquid and vapor space of SSTs. The maximum value of 0.3 mpy is the average corrosion rate over the ~ 50-yr period from the start of SST operations, derived from the maximum value of lab tests on simulated wastes. The value of 0.6 mpy is obtained by assuming the vapor space corrosion rate is a factor of 2 higher than the rate in the liquid.
B	1943-44	14-34	14-34	11-51	
C	1943-44	14-34	14-34	11-51	
T	1943-44	14-34	14-34	11-51	
U	1943-44	14-34	14-34	11-51	
BX	1946-47	13-33	13-33	11-49	
TX	1947-48	13-33	13-33	11-49	
BY	1948-49	13-33	13-33	11-48	
S	1950-51	13-32	13-32	11-47	
TY	1951-52	13-32	13-32	10-46	
SX	1953-54	13-31	13-31	10-45	
A	1954-55	13-31	13-31	10-45	
AX	1963-64	12-28	12-28	10-39	
200 SERIES TANKS					
B	1943-44	14-34	14-34	11-51	
C	1943-44	14-34	14-34	11-51	
T	1943-44	14-34	14-34	11-51	
U	1943-44	14-34	14-34	11-51	

[a] For future general corrosion rates beyond 2004 use 0.1 mpy for bottom and lower wall and 0.2 mpy for upper wall.

APPENDIX B

Operability Evaluation for the SX Ventilation System (296-S-15)

NUMBER: OE-04-003 **DATE/TIME OF REQUEST:** 4-29-2004 / 0854

TITLE: Technical Evaluation for the SX Ventilation System (296-S-15)

REVISION: 0

PER NUMBER: PER-2004-1710

OCCURRENCE REPORT: N/A

EQUIPMENT IDENTIFICATION NUMBER: 296-S-15

DEGRADED OR NONCONFORMING CONDITION:

The purpose of this evaluation is to respond to the question posed by DOE-HQ assessment team on March 13, 2004 during their investigation of tank farm vapor issues and concerns: ***"For SSTs with active ventilation, what specific analysis and/or controls are in place to prevent over pressurization or under pressurization (e.g. prevent vacuum in tank) – to assure the OSD limits for DP in tank from structural protection is met."***

REFERENCE DOCUMENTS:

HNF-SD-WM-CN-116, Rev.0-A, *Calculation Notes Hydrogen Generation*
OSD-T-151-00013, Rev.E-6, *Operating Specification for Single Shell Waste Storage Tanks*
RPP-11051, Rev. 0-A, *Technical Basis Document for Single-Shell Tank Operating Specifications*
RPP-11788, Rev. 0 *Single Shell Tank Waste Retrieval Allowable Vacuum Assessment*
RPP-10435, Rev.0 *Single Shell Tank System Integrity Assessment Report*
SD-RE-TI-035, Rev.1, *Technical Bases for Single-Shell Tank Operating Specifications*
DOE Letter 02-TED-019, *Contract No. DEAC27-99RL14047 – Deferral of a Safety Basis (SD) Amendment to Close the Justification for Continued Operation (JCO) of 241-SX Tank Farm Without Active Ventilation (dated January 7, 2003)*

AFFECTED SYSTEM(S):

The only existing SST active ventilation system, 241-SX-VTP, was installed at SX Farm in the 1970s and was originally designed to remove heat; thus, it is called the "SX sludge cooler". Temperatures in the tank are currently near ambient conditions and the system has been modified to provide less cooling by changing the sheaves between the fan motor and the fan to reduce the fan speed. Each fan was originally designed to provide a maximum capacity of 11,325 cfm at 7 inches static pressure. The original 1970 arrangement notes an exhaust stack flowrate of 22,650 cfm and is illustrated on sheet H-2-35834 Sht1, Rev. 5. This indicates that both fans were operated to produce the combined flowrate taken from tanks SX-105, SX-107, SX-108, SX-109, SX-110, SX-111, SX-112, and SX-114 which are also shown on the drawing. The flow then discharges through stack 296-S-15.

A ventilation line replacement project (Project B-384) at SX Farm was performed in the 1980's to replace some of the SX farm ventilation ducting. An "as built" project drawing shows that the replacement was completed in 1984 and drawing H-2-90866, Rev.1 illustrates three changes: In the 1984 arrangement with one fan operating; 1.) The exhaust flowrate through the stack was decreased to 6100 cfm. 2.) The second fan was used as a backup and is the current mode of operation. The fan pulled air through one exhaust HEPA filter bank. The two other banks were designed as backup trains as shown on the drawing. These two backup banks are now isolated with blank-off plates. 3.) Additionally, the drawing illustrates that the ventilation flowrate from

SX-109 (which includes the air flow entering SX-109 from SX-101, SX-102, SX-103, SX-104, SX-105 and SX-106) was 1100 cfm.

There are now three ventilation configurations used at SX Farm. The affected system covered by this evaluation is: SX Farm active exhauster 296-S-15 which provides a central dispersion point for exhaust from tanks 241-SX- 107, 108, 109, 110, 111, 112 and 114. Tanks SX-101, 102, 103, 104, 105, and 106 are equipped with breather filters installed with oil seal loops. Tanks SX-113 and SX-115 are not connected to the active exhaust system and are equipped with breather filters installed with oil seal loops.
The current system arrangement is illustrated on drawing H-14-020134. SX Farm includes 15 SSTs with a capacity of 750,000 gallons each. A HEPA filtered air inlet station provides air into SX-109. A typical inlet station is shown in drawing H-2-79952. HEPA inlet stations in lieu of breather filters are provided at tanks SX-107, SX-108, SX-109, SX-110, SX-111, SX-112 and SX-114

Tanks SX-101 through SX-106, SX-113 and SX-115 have breather filters installed. Tanks SX-101 through SX-106 are exhausted through SX-109. However, tank psychrometric test results indicate that there may be low airflow through them.

Tank over pressurization and under pressurization is minimized on passively ventilated Single Shell Tanks SX-101, 102, 103, 104, 105, 106, 113, and 115 with the use of breather filter oil seal loops. However, Tanks SX-107, 108, 109, 110, 111, 112 and 114 do not use breather filters nor are there oil seal loops. These tanks have inlet stations installed with no design feature for over pressurization or under pressurization relief.

Exhaust from SX-109 is routed through a 12" pipe to a common header, then through the filter system and fan before being discharged through the stack to the atmosphere. The Single Shell Tank Waste Retrieval Allowable Vacuum Assessment, RPP-11788, concludes that the maximum allowable vacuum is 9 inches water gauge (in. w.g.) in this tank. The existing fan does not have the capacity to draw a vacuum of 9 inches.

DESIGN REQUIREMENTS:

The Operating Specification Document for SSTs is OSD-T-151-00013 with supporting basis document RPP-11051, *Technical Basis Document for Single-Shell Tank Operating Specifications*. The OSD basis for the SST vacuum limits is RPP-11788, *Single Shell Tank Waste Retrieval Allowable Vacuum Assessment*. RPP-11788 provides allowable vacuum limits to guard against bottom uplift or buckling of the steel liner during waste retrieval activities as the waste level is reduced. This document does not specifically evaluate the ultimate capacity of the concrete tank structure against vacuum loading since the vacuum limits on the ¼-inch thick steel liner for bottom uplift are more restrictive as the tank is emptied. When there is sufficient static pressure due to waste in the tank counteracting vacuum pressure loading, the previous OSD maximum vacuum limit of 9 in. water gauge (w.g.) was retained.

The existing revision of RPP-11788 (Rev 0) addresses the potential for the tank wall to buckle therefore; complying with the limits in the OSD will ensure the limits in RPP-11788 are not exceeded.

The steel tank liners of the SSTs were designed to the following design standards (RPP-10435, 2002, *Single-Shell Tank System Integrity Assessment Report*):

Tanks	Design Standard
B, C, T, U, BX, TX, and SX	Standard Specification for Elevated Steel Water Tanks, Standpipes and Reservoirs per American Waterworks Association (AWWA)

Document, HNF-SD-WM-CN-116, Rev. 0-A, "Calculation Notes Hydrogen Generation Rates at Steady State Flammable Gas Concentrations for SST" states the barometric breathing rate in Tanks 241-SX-113 and 241-SX-115 is 0.52 cfm and 0.53 cfm respectively. This low breathing rate is assumed to be the same for all SX tanks.

REGULATORY COMMITMENTS:

The SX Tank Farm exhauster is used to control emissions. The exhauster maintains a vacuum on the waste tanks to minimize the potential for emissions from the tank. Slight positive pressures force contamination out of the tank.

Controlling tank vacuum pressure is necessary in order to comply with the tank Operating Specifications (*Operating Specifications for Single-Shell Waste Storage Tanks*, OSD-T-151-00013), which specify a maximum vacuum limit dependent on waste height.

An earlier operability evaluation (OE) was written in response to PER-2001-1982 and concluded that the SX Ventilation System was not operable based on the lack of flow monitoring or vacuum monitoring as required under a now outdated FSAR document, HNF-SD-WM-SAR-067. The FSAR has been replaced with a Documented Safety Analysis (DSA) that no longer requires SX Tank Farm Active Ventilation.

In a letter dated January 7, 2003 (DOE letter 02-TED-019) DOE directed CH2M HILL to implement a Safety Basis amendment to reflect the passive ventilation configuration and applicable controls no later than April 10th 2004 or by the DSA implementation date, whichever came first. The letter directed that all SX Tank Farms shall be passively ventilated by the time of the DSA implementation. Engineering provided Operations with a preliminary design work, task, and milestone timeline schedule providing critical path to complete this work.

On April 8, 2003, activities to implement passive ventilation on all SX Tank Farms were placed on hold pending re-negotiation with the deliverable date due to lack of funding during FY 2003 with DOE. Also, active ventilation was required in 2003 during saltwell pumping activities in the SX Farm. Saltwell activities were completed in 2003.

SAFETY FUNCTION(S):

No TSR Requirements.
The Washington Administrative Code (WAC) chapter WAC 246-247-030 and WAC 246-247-110 Appendix A.
ASME/ANSI AG-1, Code on Nuclear Air and Gas Treatment
ASME/ANSI N509, Nuclear Power Plant Air-Cleaning Units and Components
ASME/ANSI N510, Testing of Nuclear Air Treatment Systems
40 CFR 60, Appendix A Methods
ANSI N13.1, Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities.

EFFECT ON HARDWARE:

Historically, maximum tank vacuum limits identified in the OSD have not been an issue because the tanks contain sufficient waste levels and tank ventilation systems are generally not capable of producing enough vacuum in the tank. To maintain minimal vacuum it has been necessary to seal all visible tank intrusions with tape/foam and to throttle the isolation valves for the air inlet stations.

The reduced allowable vacuum limits resulting from waste removal from the tanks requires the use of variable methods and controls to maintain the tank vacuum within the allowable limits. The following is a summary of these vacuum control techniques.

Vacuum limiting techniques used for SX Exhauster Operation

Breather filter Seal loops - These are installed on eight of the SX Farm Tanks with breather filters to provide vacuum/pressure relief. They are designed as a pressure relief in the event of over/under pressurization and are refilled periodically to maintain containment.

Inlet HEPA Filters – Inlet HEPA filters are installed on all other SX Farm Tanks. The purpose of the inlet filter is to provide a source of air in-leakage with sufficient capacity to offset the air being withdrawn from the tank by the exhauster, and is controlled by a manually adjusted damper. Typical pressure drops for clean HEPA filters are around 1.0 in w.g. (clean) at the rated flow. The pressure drop will increase as the filters collect particulate material.

Outlet Dampers – They are provided at the exhaust duct from each of the actively ventilated tanks. This arrangement working in conjunction with the tank air inlet damper allows for a more precise exhaust air balancing.

Exhauster controls – The exhaust fans are provided with vane axial dampers manually adjusted to obtain the specified air quantity allowed from the system.

Administrative controls: Active exhaust ventilation operation is monitored daily. Preventive Maintenance and Testing is also provided.

Vacuum increasing techniques for SX Exhauster Operation Indication

The available methods used to increase tank vacuum and to minimize emissions are discussed below:

Tape/foam – Adding sealing tape or foam to tank intrusions results in increased vacuum levels in the tank by reducing air in-leakage paths. The various tank pits are sealed with tape/foam to eliminate the radiological and chemical emissions.

Manual valve/damper –Manual valves/dampers are used to increase the vacuum level in a tank by restricting air flow into that tank. Flow is adjusted in Psychrometrics calculations performed annually using one exhaust fan. Exhaust fans inlet vaneaxial dampers and tank inlet valves/dampers and also dampers in tank exhaust ducts are manually positioned in accordance with the air flow balancing test results and maintained in this position through administrative controls.

Administrative controls: During exhauster operation rounds are taken on the filter differential pressures and visual and audible high vacuum alarms alert personnel that existing tank vacuum conditions exist and may require operator action. See Attachment 1.

TECHNICAL RECOMMENDATION:

The conclusion of this evaluation is that the SX Farm exhaust unit active ventilation system can be operated within the allowed OSD limits for tank vacuum.

The combination of technologies currently used to control vacuum at SX Farm has proven effective for maintaining safe design tank vacuum levels. A worst case scenario was considered in Attachment 2. The worst case scenario for vacuum control considered one SX Farm tank in service with one exhaust fan on-line. In the unlikely event that all exhaust dampers are closed at all tanks with the exception of one tank, there is insufficient vacuum available to cause structural damage with the operating exhauster.

The combination includes balancing airflow using inlet dampers, outlet dampers at the exhaust duct from the tank and vaneaxial dampers at the fan using administrative controls.

Vacuum control methods also include using existing waste in the tanks to provide a static pressure head on the tank. The SX Tank with the lowest waste level is Tank 241-SX-110. The waste level of 28.5 inches above the tank bottom produces static pressure head of +34.5 in. w.g. which is well above the allowed -9 in. w.g vacuum.

For an empty SX single shell tank, the allowable vacuum identified in OSD-T-151-00013, Rev. E-6 is - 1.9 in. w.g.

The highest vacuum we have in any of the SX Tank Farm tanks is equal to - 0.86 in. w.g. (241-SX-114) as documented during the most recent psychrometric test under work package 2W-03-00109/P.

Improbable events such as intentional malicious acts, or highly improbable equipment malfunctions are not considered as expected or anticipated initiators of excessive vacuum spikes.

The SX exhauster is environmentally permitted as a "minor" stack. If future SX Tank waste retrieval is required, or if saltwell pumping is required, or if core sampling is required, then the SX exhauster will need to be reclassified as a "Major" stack and will have to comply with ANSI N13.1- 1999. This will involve a costly major upgrade. The environmental permit will not allow operation past December 30th 2005. The use of portable exhausters will be employed when active ventilation is required for waste retrieval.

COMPENSATORY MEASURES:

None.

Evaluator: GJ Gauck [signature] Date: 4/29/04.

Reviewer: T E Douay [signature] Date: 4/29/04

Responsible Engineering Manager MJ Sutey [signature] Date: 4/29/04

Closure Projects Shift Operations Manager Receipt: [signature] Date: 4/29/04

Time: 1330

Closure Projects Shift Operations Manager: [signature] Rakesh Mohan Date: 5-5-04

Operations Review:

Operations declares the system: ☒ OPERABLE ☐ Not OPERABLE

Comments: ______________________

Closure Projects Shift Operations Manager: [signature] Rakesh Mohan

Date: 5-5-04
Time: 1600 hr

Attachment 1
Administrative Controls Data Summary

Instrumentation Setpoints (JCS-PM/S Data Sheets)

Component Number	Component Name	Alarm Setpoint	Interlock Setpoint	Data Sheet Number
SX241-VTP-PDSL-241	Differential Pressure Alarm Switch	-0.05" w.g.	-0.05" w.g.	WT-01115
SX241-VTP-PDSL-242	Differential Pressure Alarm Switch	-0.05" w.g.	-0.05" w.g.	WT-01121
SX241-VTP-PDSH-241	Differential Pressure Alarm Switch	-5.0" w.g.		WT-01142
SX241-VTP-PDSH-242	Differential Pressure Alarm Switch	-5.0" w.g.		WT-01120

Drawings

Drawing Number	Type of Drawing	Sheet Number	Revision Number
H-2-35835	Ventilation Plan and Details	1	3
H-2-35834	Ventilation Air Flow Diagram (Partially superseded by H-14-020134 sheets 1 and 2)	1	5
H-14-020134	Ventilation Tank Primary System (VTP) O&M System P&ID	1	5
H-14-020134	Ventilation Tank Primary System (VTP) O&M System P&ID	2	6
H-14-020134	Ventilation Tank Primary System (VTP) O&M System P&ID	3	3
H-14-030034	Electrical (EDS) One Line Diagram	2	5
H-2-35831	Electrical Plan and Elevations (Shows dP locations)	1	5
H-2-35832	Electrical Diagrams (Annunciator and Fan Motor Elementary Diagrams)	1	3
H-2-35849	Engineering Flow Diagram (Ventilation System)	1	12

Discussion

The 241-SX Tank Farm ventilation system (Sludge Cooler) is comprised of various ducts, filters, two fans and a single exhaust stack. The reference drawings indicate the control system strategies and the equipment being utilized. The fan motor control circuits have a shutdown when a blow through occurs (vacuum of 0.05" w.g. nominal or less) on either the pre-filter and first stage HEPA filter (PDSL-241) or the second stage HEPA filter (PDSL-242). In addition, this low vacuum condition will cause alarms on the annunciator panel in the 241-SX-271 building.

When a high vacuum (5.0" w.g. nominal or more) occurs across either the pre-filter and first stage HEPA filter (PDSH-241) or the second stage HEPA filter (PDSH-242) an alarm is actuated.

The Alarm Response Procedure ARP-T-421-00008, identifies the actions to be taken by the Operations staff should any of these alarms occur.

Attachment 2

Worst Case Scenario Summary

The worst case scenario of vacuum control needs at SX Farm considered one SX Tank Farm Tank in service with one exhaust fan on-line. All remaining tanks were assumed to have their isolation dampers closed. The maximum air flow (2924 CFM) was assumed to exhaust through one on-line tank.

The estimated static pressure loss is as follows:

Total pressure loss:	5.9 in w.g.
- Ductwork:	-0.2 in w.g.
- Clean HEPA Filter/Prefilter (1x1)	-3.38 in w.g.
- Exhaust HEPA (3x3 filter arrangt)	-0.43 in.w.g.
- Dampers, fittings:	-1.5 in w.g.
The maximum possible Tank Vacuum is:	-0.39 in w.g.

As noted in the most recent psychrometric testing (see work package 2W-03-001109/P), the operating exhaust fan produced an airflow rate of 2924 CFM at -5.9 in w.g. Since the most tank vacuum recorded in SX Farm is -0.86 in. w.g. (Tank 241-SX-114) during normal operation, even with all exhaust dampers closed to all tanks with the exception of one tank, there is insufficient vacuum available to cause structural damage with the operating exhauster.

As the active ventilation HEPA filter continues to build up particulate matter during operation of the exhaust fan, the flow resistance across the filter will continue to increase.

The conclusion is that no structural damage is possible to the tank.

APPENDIX C

Technical Evaluation for C-200 Vacuum Pump Potential for Causing Vacuum within C-200 Tanks in Excess of Established OSD Limits

OPERABILITY/TECHNICAL EVALUATION

NUMBER: TE-04-004 DATE/TIME OF REQUEST: 4/21/04 / 17:15

TITLE: Operability/Technical Evaluation for C-200 Vacuum Pump Potential for Causing Vacuum within C-200 Tanks in Excess of Established OSD Limits

REVISION: 0

PER NUMBER: 2004-2246

OCCURRENCE REPORT: N/A

EQUIPMENT IDENTIFICATION NUMBER:
Vacuum Pump 1, Vacuum Pump 2, AMS-01, AMS-02, AMS-03, AMS-04, EXH-1001-HIH.

DEGRADED OR NONCONFORMING CONDITION:
PER 2004-2246 states verbatim, the following:

"The vacuum pumps in the mobile retrieval system for C-200 tanks are capable of producing a vacuum condition in excess of the C-200 series tanks structural capability. No Operability/Technical Evaluation has been identified that assesses the installed configuration for adequacy of system controls to prevent damage to the tank has been identified. Discussions with project engineering personnel indicated that tank structural integrity is protected solely by administrative controls that ensure correct vacuum pump discharge hose connection. This does not address the potential for a vacuum pump discharge line hose or piping failure or leak. This condition was identified during development of cause analysis for PER-2004-1710."

REFERENCE DOCUMENTS:
H-14-106126, Shts. 3,4,5,6,7 & 8, - P&ID's for C-201, 202, 203 and 204 retrieval system configurations respectively.
H-14-106127, Sht. 3 - WRS PLC to MRS PLC Permissive
H-14-106132, Sht. 1 - C-200 Series Interface Control Diagram
H-2-90718, Sht. 3 - Inlet Filter Piping Installation
H-14-106244, Sht. 3 - POR03 Exhauster Configuration for Waste Retrieval
Vendor Drawings GA-C200-VAC-002, 003 GA-C200-PPS-001, 003 – Vacuum and Vessel/Pump Skid General Arrangement Drawings
RPP-17190 - Safety Evaluation of the C-200 Retrieval System
RPP-17742 - Technical Basis for Vacuum Exhaust Line Rupture Representative Accident
6-PCD-373 - Yokogawa Instruments EJA 110 & 120 Differential Pressure Transmitter
WT-07759 - C201-VTP-PDIT-210 Calibration
WT-07760 - C202-VTP-PDIT-220 Calibration

WT-07761 - C203-VTP-PDIT-230 Calibration
WT-07762 - C204-VTP-PDIT-240 Calibration
OSD-T-151-00013 - Operating Specifications for Single Shell Storage Tanks
RPP-11413 - Technical Basis for Ventilation Requirements in Operating Spec.Documents
RPP-16667 - Vendor Acceptance Test Report for HIHTL
RPP-16666 - HIHTL Integrity Assessment/OTP
Air 03-704 - Department of health Radioactive Air Emissions Notice of Construction Approval for 241C-200 Series Tanks Retrieval
RPP-16945 - Process Control Plan, control 3.2.1 "Tank Pressure"
RPP-14075 - WRS Level 2 Specification, Section 3.2.1.2
RPP-7420 - MRS Performance Specification

AFFECTED SYSTEM(S):
241- C-201, 202, 203 and 204 tank structures.

DESIGN REQUIREMENTS:
The Mobile Retrieval System for the C-200 Series was designed to use vacuum to retrieve tank waste. Listed below are the requirements that affect the C-200 Series tank structures.

OSD-T-151-00013 requires that the C200 Series SSTs not exceed vacuum greater than -5.3 inches wg with an empty tank. This value is to protect the tank bottom from being up lifted. The basis for this value resides in RPP-11413.

1. There are two vacuum pumps that are used to create the vacuum. The two vacuum pumps may be operated simultaneously for a combined flow rate of 600 ft^3/min, or individually for a flow rate of 450 ft^3/min. The maximum vacuum that the vacuum retrieval system can achieve is ~ -12.5 psig (preset vacuum breakers are on suction line) when deadheaded. The Mobile Retrieval System pulls from and returns to the same tank. This way the net air flow and pressure change is approximately zero.

2. The tank outlet to the POR03 exhauster has a Pressure Differential Indicating Transmitter (PDIT). The PDIT is interlocked to shutdown the MRS equipment (i.e. vacuum pumps) if the tank vacuum is too high (greater than 5.0 inches wg).

3. Each tank has an inlet HEPA filter that allows the tank to breathe to the environment. The breather filter also has a seal loop that clears if the vacuum increases above 4 inches wg.

4. The Hose-In-Hose Transfer Line (HIHTL) used for the vacuum discharge return to tank has been qualified through rigorous testing per RPP-16666 – Integrity Assessment/OTP and RPP-16667 – Vendor Acceptance Test Report for HIHTL.

This testing includes burst pressures and guillotine testing. Normal discharge pressures of 2-3 psi are seen when the vacuum pumps are operating, which are well below the pressure rating of the HIHTL, making the possibility of rupture of the discharge hose extremely low. Should the vacuum discharge HIHTL become 'pinched' off or crushed, temperature trips are in the motor drive for the vacuum pumps that will shutdown the vacuum system. Additionally, vehicle barriers are installed to preclude vehicle traffic in the area.

5. All flange connections of the discharge hose, including gasket integrity, placement and torqueing are Quality Control Hold Points in the installation work packages.

REGULATORY COMMITMENTS:
OSD-T-151-00013 – Operating Specifications for Single Shell Storage Tanks.

The tank vacuum must be less than -5.3 inches of water to prevent up lift of the tank bottom.

Air 03-704 – Department of Health Radioactive Air Emissions Notice of Construction Approval for 241-C-200 Series Tanks Retrieval.

The NOC requires that the vacuum pump(s) return line be routed to the tank that is being retrieved.

SAFETY FUNCTION(S):
It has been determined by Nuclear Safety and Licensing that the C-200 Series tanks are General Service and provide no safety significant function. The tanks structure is used to contain waste and prevent a radiological/toxilogical release to the environment.

The vacuum discharge line, EXH-1001-HIH has been determined to be Safety significant due to toxilogical release potential if the line should rupture.

EFFECT ON HARDWARE:
The Mobile Retrieval System was designed to retrieve air and waste from the C-200 Series tanks. This is accomplished by the vacuum pumps creating a vacuum on a slurry tank in the POR79 skid. The slurry tank then pulls a vacuum on a pipe within the C-200 Series tank. The pipe is used to focus the vacuum in a specific point within the tank causing the waste to be lifted up into the pipe and removed from the tank. The return line from the vacuum pumps returns the air back to the tank precluding a pressure change within the tank. There will be a small pressure change during start up and shutdown of equipment but this will not be noticed because the POR03 exhauster will be operating during retrieval activities.

A high vacuum could be created in the C-200 Series tank if the following occurs:

1. The vacuum pump discharge line back to the retrieval tank became ruptured or was misrouted to another tank AND,
2. PDIT failed in a condition that showed no high or low vacuum (greater than 5.0 inches wg or less than 0.2 inches wg).

The vacuum pump return line is a safety significant (SS) HIHTL and is protected against rupture by installing vehicle impact barriers. This prevents any equipment from coming into contact with the HIHTL and rupturing it.

The HIHTL has a number of administrate checks in place to ensure that the hose is not connected to another tank. The first check is within the work package that installs the HIHTL (i.e QC witness the installation and updates routing board). The second check is when the engineer signs off the ECN. The third check is with the operating procedure TO-220-106 that verifies, before startup, that the HIHTL has been connected to the correct tank.

The PDIT failure modes will put the pressure outside of the normal operating range which will shutdown the vacuum pumps.

From the discussion listed above, the chances to have a high vacuum within the C-200 Series tanks caused by the POR78 vacuum pumps are very low.

There are no known or observed short or long term effects on the tanks or associated retrieval equipment. All components in the system vacuum loop are rated for vacuum at extended operation.

The increase in vacuum accident has been analyzed by Nuclear Safety and Licensing in RPP-17190 resulting in the determination that the accident would not result in unacceptable on-site worker consequences.

TECHNICAL RECOMMENDATION:
The technical evaluation listed above shows that the system is designed to prevent the tank vacuum from exceeding the requirements in OSD-T-151-00013.

COMPENSATORY MEASURES:
None recommended. The current controls are adequate to protect the C-200 Series tank structure.

C-200 MOBILE RETRIEVAL SYSTEM

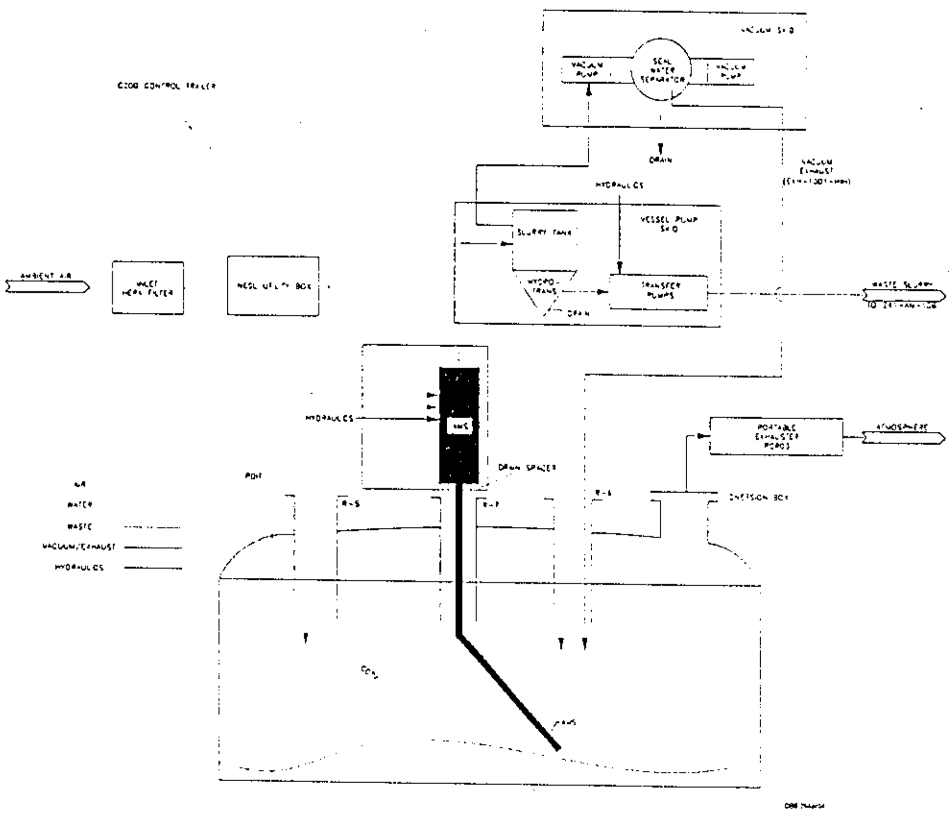

FIGURE 1

BEST AVAILABLE COPY

Evaluator: D B Smet Date: 06 May 04

Reviewer: D. B. Parkman Date: 5/6/04

Responsible Engineering Manager MJ Sutey Date: 5/6/04

Waste Feed Operations Shift Operations Manager Receipt: Date: 5/10/04
Time: 1432 hrs
Waste Feed Operations Shift Operations Manager:

Operations Review: Del Scott

Operations declares the system: ☒ OPERABLE ☐ Not OPERABLE

Comments: Appropriate controls are in place to preclude negative pressure damage to tanks.

Waste Feed Operations Shift Operations Manager:

Date: 5/14/04
Time: 1120 hrs

APPENDIX D

Technical Evaluation for 244-AR & 244-CR vault tanks with respect to potential high pressure or vacuum conditions

NUMBER: TE-04-007 **DATE/TIME OF REQUEST:** 5-28-2004 / 0748

TITLE: Technical Evaluation for 244-AR & 244-CR vault tanks with respect to potential high pressure or vacuum conditions.

REVISION: 0

PER NUMBER: PER-2004-1710 SIGNIFICANT ACTION

OCCURRENCE REPORT: N/A

EQUIPMENT IDENTIFICATION NUMBER: 244-AR / 244-CR VAULT

DEGRADED OR NONCONFORMING CONDITION:

This purpose of this technical evaluation is to respond to a question posed by Engineering Services in PER-2004-1710 on 5/28/2004 resulting from an investigation by the DOE-HQ assessment team on March 13, 2004. During their investigation of tank farm vapor issues their concern was identified as follows: ***"For SSTs with active ventilation, what specific analysis and/or controls are in place to prevent over pressurization or under pressurization (e.g. prevent vacuum in tank) – to assure the OSD limits for DP in tank from structural protection is met."***

REFERENCE DOCUMENTS:

HNF-SD-WM-TSR-006 REV 3	Tank Farms Technical Safety Requirements.
RPP-12051 REV 0	244-AR Vault Interim Stabilization Completion Report.
RPP-11829 REV 1	Federal Facility Compliance Agreement: Stack Isolation Project Functions and Requirements.
WAC 246-247-080(6)	Radiation Protection/Air emission/Inspections, reporting, and recordkeeping.

AFFECTED SYSTEM(S):

The vault tanks associated with 244-AR are listed as follows: TK-001, -002, -003, and -004. These four tanks were actively ventilated up until the completion of the interim stabilization, which at that point the fan motors became de-energized and connections de-terminated, (H-2-62019 sheet 3 Rev 11). POR05 and POR06 were used at 244-AR prior to September 2003. POR05 has been moved to S-102, and POR06 is in the process of moving to B-200. Likewise, the vault tanks associated with 244-CR are as follows: 244-TK-CR-001, -002, -003, and -011. The 244-CR active exhaust ventilation 296-C-05 is a designated stack (major) which is out of service with no current plan for future use, and will be regulatory closed via WAC 246-247-080(6). The electrical power has been de-energized and de-terminated (H-14-030013 sheet 3 Rev 6), following the completion of the 244-CR tank interim stabilization.

DESIGN REQUIREMENTS:

None required with the exhaust fans electrically de-terminated.

REGULATORY COMMITMENTS:

244-CR Decommissioning Notice of Construction (NOC-548) has been issued, however not all mechanical isolation has been completed. The Federal Facility Compliance Agreement Stack Isolation Project (RPP-11829) states that the stack will be mechanically isolated by December

31,2005.

244-AR Decommissioning Notice of Construction (NOC) has been submitted to Washington State for approval.

SAFETY FUNCTION(S):
N/A

EFFECT ON HARDWARE:
N/A

TECHNICAL RECOMMENDATION:

Section 5.2 Ventilation System, of RPP-12051, REV 0 244-AR Vault Interim Stabilization Completion Report states, "Operation of the ventilation system in the current configuration would be performed under existing procedure TO-060-087, *Operate Ventilation System for 244-AR Waste Transfer*. However, this procedure is currently inactive and would have to become active and fan motor electrically re-connected before operation could occur. RPP-12051 should be revised to reflect the current configuration of 244-AR and to show that TO-060-087 has become inactive.

COMPENSATORY MEASURES:
N/A

Evaluator: Brian Klump/Brian Klump Troy Farris [signature] Date: 6-14-04

Reviewer: Steve Krogsrud [signature] Date: 6/15/04

Responsible Engineering Manager: MJ Sutey [signature] Date: 6/15/04

Closure Projects Shift Operations Manager Receipt:________ Date:________
Time: ________
Closure Projects Shift Operations Manager: ________ Date:________

Operations Review:

Operations declares the system: ☐ OPERABLE ☐ Not OPERABLE

Comments: ________________________________

Closure Projects Shift Operations Manager: ________________

Date: ________
Time: ________

Attachment 1
Administrative Controls Data Summary

Drawings

Drawing Number	Type of Drawing	Sheet Number	Revision Number
H-2-62019	Electrical One Line Diagram	3	11
H-14-030013	Electrical (EDS) One Line Diagram	3	6

Discussion

Section 5.2 Ventilation System, of RPP-12051, REV 0 244-AR Vault Interim Stabilization Completion Report states, "Operation of the ventilation system in the current configuration would be performed under existing procedure TO-060-087, *Operate Ventilation System for 244-AR Waste Transfer.* However, this procedure is currently inactive and would have to become active and fan motor electrically re-connected before operation could occur.

In conclusion to this evaluation, the active ventilation systems at 244-AR and 244-CR are shown to have been electrically disconnected. The AR-Vault exhauster fans are shown to be "out of service" and show an electrical disconnect, (H-2-62019 sheet 3 Rev 11). Portable exhausters 05 and 06 were used on 244-AR. At this time POR05 has been moved from this location and POR06 is in the process of being moved. The CR-Vault exhauster (i.e. fan motors) has been electrically de-energized, (H-14-030013 sheet 3 Rev 6).

According to the existing TSR, (HNF-SD-WM-TSR-006 REV 3) 244-CR and 244-AR vault tanks are listed as Inactive tanks and vessels. Concerns of potential high pressure or vacuum conditions due to the active ventilation systems are thus eliminated.

APPENDIX E

Evaluation for Double Contained Receiver Tanks 244-BX, 244-S, 244-TX

PER-2004-1710.13 Date: June 15, 2004 By: Theo. E. Douay

Other TFC facilities with actively-ventilated tanks that are subject to potential high pressure or vacuum conditions are the 244-S, 244-BX and 244-TX Double Contained Receiver Tanks. (DCRT).

The ventilation systems for these tank farms are shown on drawing H-2-73838, H-14-020641, H-14-020153.

The drawings show the following flow rate values for the active ventilation systems:

244-S Exhaust Fan 165 CFM with 130 CFM from the annulus and 35 CFM from the tank.
244-BX Exhaust Fan 250CFM with 125 CFM from the annulus and 125 CFM from the tank
244-TX Exhaust Fan 250CFM with 125 CFM from the annulus and 125 CFM from the tank.

The actual flow rate field measurements using the psychrometric charts were as follows:

244-S Exhaust Fan 119 CFM per Work Package 2W-04-00808;
244-BX Exhaust Fan 183 CFM per Work Package 2W-04-00096;
244-TX Exhaust Fan 285 CFM per Work Package 2W-04-00512

At the mixing point where airflow from the annulus mixes with airflow from the tank inside vapor space a motorized isolation damper can close the airflow from the annulus damper should the damper inadvertently fails shut. Under this worse condition, preliminary airflow calculations indicate that the airflow resistance would become approximately 5" WG for the ductwork/HEPA filters which would leave only 0.25" WG at the tank interior vapor space itself.

In conclusion, under the worse case scenario no resulting structural damage would happen to tanks at 244-S, 244-BX, and 244-TX