OFFICE OF RIVER PROTECTION
P.O. Box 450, MSIN H6-60
Richland, Washington 99352

RECEIVED
2014 SEP 15 PM 3: 44
DNF SAFETY BOARD

14-TF-0104

SEP 1 0 2014

The Honorable Peter S. Winokur, Chairman
Defense Nuclear Facilities Safety Board
625 Indiana Avenue, NW, Suite 700
Washington, DC 20004

Mr. Chairman:

TRANSMITTAL OF DEFENSE NUCLEAR FACILITIES SAFETY BOARD RECOMMENDATION 2012-2 IMPLEMENTATION PLAN DELIVERABLE FOR ACTION 1-2

This letter provides the streamlined approach proposed by Washington River Protection Solutions LLC for upgrading the double-shell tank (DST) primary ventilation systems to meet safety significant requirements referenced in Action 1-2 of the U. S. Department of Energy Implementation Plan for Defense Nuclear Facilities Safety Board Recommendation 2012-2, Hanford Tank Farms Flammable Gas Safety Strategy.

The attachment provides the report RPP-RPT-57356, *Streamlined Approach to Upgrading DST Primary Tank Ventilation.* This report proposes using portable exhausters with self-contained generator units to provide the necessary air flow when the flammable gas hazard exists and the DST primary tank ventilation system is inoperable. The report also includes assumptions, design requirements, permitting requirements, operational requirements, and rough order of magnitude estimates of cost and duration to implement.

The U.S. Department of Energy, Office of River Protection has not completed its evaluation of the proposed streamlined approach to upgrading the DST primary ventilation systems and has not made a decision on implementation at this time. We expect to complete the evaluation in early Fiscal Year 2015.

Kevin W. Smith

Kevin W. Smith
Manager

SEP 1 0 2014

Attachment

cc w/attach:
D.M. Gutowski, DNFSB
R.G. Quirk, DNFSB
M. Whitney, EM-1, Acting
C. J. Jones, EM-1
R.H. Lagdon, Jr., EM-1
M.C. Regalbuto, EM-2.1
K.G. Picha, EM-20
T.A. Shrader, EM-23
J. Hutton, EM-40, Acting
T.N. LaPointe, EM-41
J.D. Lorence, EM-41
J. Olencz, HS-1.1
D.L. Olson, WRPS
WRPS Correspondence

ATTACHMENT

14-TF-0104

RPP-RPT-57356, Rev. 0: STEREAMLINE APPROACH TO UPGRADING DST PRIMARY TANK VENTILATION

Streamlined Approach to Upgrading DST Primary Tank Ventilation

Author Name:
R.E. Mitchell
Washington River Protection Solutions, LLC
Richland, WA 99352
U.S. Department of Energy Contract DE-AC27-08RV14800

EDT/ECN: 825719 UC:
Cost Center: Charge Code:
B&R Code: Total Pages: 26

Key Words: DST primary tank ventilation system, DNFSB, streamlined approach, portable exhauster, flammable gas, gas release event, headspace

Abstract: This report directly supports DNFSB 2012-2, Action 1-2, which is outlined within the Implementation Plan, Sub-recommendation 1. Action 1-2 provides direction to develop a streamlined approach to implementing the planned improvements for upgrading the DST primary tank ventilation system to meet SS requirements. WRPS was tasked with providing a technically sound, yet more practical alternative to the current planned improvements. WRPS has developed a portable exhauster concept that could be deployed in an emergency situation to directly ventilate each DST of flammable gas via an emergency response plan.

APPROVED
By GE Bratton at 2:25 pm, Jul 28, 2014

DATE:
Jul 28, 2014
HANFORD
RELEASE

Release Approval Date Release Stamp

Approved For Public Release

RPP-RPT-57356
Revision 0

Streamlined Approach to Upgrading DST Primary Tank Ventilation

Prepared by:

R.E. Mitchell
Washington River Protection Solutions, LLC

Date Published
July 2014

Washington River Protection Solutions LLC
Contractor for the U.S. Department of Energy
Contract No. DE-AC27-08RV14800

EXECUTIVE SUMMARY

In September 2012, Defense Nuclear Facilities Safety Board (DNFSB) issued DNFSB Recommendation 2012-2, *Hanford Tank Farms Flammable Gas Safety Strategy*, which included within it five recommendations (hereafter referred to as Sub-Recommendations) and associated actions. In general, DNFSB Recommendation 2012-2 identified the need to take action to reduce the potential risk posed by flammable gas events at the Hanford Tanks Farms. The United States Department of Energy (DOE) responded to the DNFSB Recommendation 2012-2 with the *Implementation Plan for Defense Nuclear Facilities Safety Board Recommendation 2012-2, Hanford Tank Farms Flammable Gas Safety Strategy* (hereafter referred to as the *Implementation Plan*).

This report directly supports Action 1-2, which is outlined within the *Implementation Plan,* Sub-Recommendation 1. Action 1-2 provides direction to develop a streamlined approach to implementing the planned improvements for upgrading the double-shell tank (DST) primary tank ventilation systems to meet safety-significant (SS) requirements.

Washington River Protection Solutions, LLC (hereafter referred to as the Tank Operations Contractor [TOC]), was tasked with providing a technically sound, yet more practical alternative to the current planned improvements. The streamlined approach proposed in this report requires a shift from the current control paradigm. The new control paradigm would focus on deployment of an alternate source of ventilation when warranted by the hazard, rather than upgrading the DST ventilation systems to meet all SS requirements to address flammable gas hazards.

TOC has developed a portable exhauster concept that could be deployed in an emergency situation where there are elevated flammable gas levels (i.e., >25% of the lower flammability limit [LFL]) to directly ventilate the affected DST(s) to remove flammable gas.

TABLE OF CONTENTS

FIGURES

TABLES

ACRONYMS

ALARA	As low as reasonably achievable
AMCA	Air Movement and Control Association
ANSI	American National Standards Institue
DNFSB	Defense Nuclear Facilities Safety Board
DOE	U.S. Department of Energy
DSA	Documented Safety Analysis
DST	double-shell tank
GRE	gas release event
GS	General Service
LCO	Limiting Condition of Operation
LFL	lower flammability limit
NFPA	National Fire Protection Association
ORP	DOE Office of River Protection
ROM	rough order of magnitude
SAC	Specific Adminstrative Control
SS	Safety-Significant
SSC	Structures, Systems, and Components
TOC	Tank Operations Contractor
TSR	Technical Safety Requirements
VFD	Variable Frequency Drive
WDOH	Washington State Department of Health
WS DOE	Washington State Department of Ecology

1.0 BACKGROUND

The historical perspective on how the actions associated with upgrading the DST primary tank ventilation systems (including Action 1-2 which is the subject of this report) evolved is as follows. In early 2010 as a part of a major upgrade to RPP-13033, *Tank Farms Documented Safety Analysis* (DSA), the steady-state flammable gas strategy for DSTs (which included SS DST primary tank ventilation systems as a control) was re-evaluated. Based on a number of considerations, a Specific Administrative Control (SAC) requiring flammable gas monitoring and stipulating actions to be taken if the flammable gas concentration was found to be > 25% of the LFL replaced the SS DST primary tank ventilation systems as the preventive control for steady-state flammable gas hazards in DSTs. Given this reliance on the SAC, the DST primary tank ventilation systems were no longer classified as SS in the tank farms DSA (i.e., the systems became General Service [GS]).

In August 2010, the DNFSB questioned DOE on the adequacy of using the SAC for flammable gas monitoring as the primary control to prevent steady-state flammable gas hazards in DSTs. In March 2011, in an effort to elevate the safety importance of maintaining active primary ventilation at all times, the DOE Office of River Protection (ORP) directed the TOC to submit a safety basis amendment that designated the existing, GS DST primary tank ventilation systems as SS. TOC was also directed to perform a gap analysis to identify differences between the functional and performance requirements for the SS systems and the existing system designs. This gap analysis was to be used to identify planned improvements to the DST primary tank ventilation systems in the safety basis amendment.

In September of 2012, DNFSB Recommendation 2012-2, *Hanford Tank Farms Flammable Gas Safety Strategy*, was issued. Within this recommendation it was noted that, although DOE maintains a commitment to upgrading the DST ventilation systems, limited progress has been made. A number of recommendations were provided regarding near term actions that should be taken to implement the DST primary tank ventilation system upgrades to SS.

DOE responded to DNFSB Recommendation 2012-2 with the *Implementation Plan,* which identifies the need to take action to reduce the risk posed by flammable gas events at the Hanford Tank Farms and includes five Sub-Recommendations and associated action items that address the DNFSB recommendations.

Action 1-2 is associated with DNFSB Sub-Recommendation 1 which reads: "Take near-term action to restore the classification of the DST ventilation systems to SS. In the process, determine the necessary attributes of an adequate active ventilation system that can deliver the required flow rates within the time-frame necessary to prevent and mitigate the site-specific flammable gas hazards at the Hanford Tank Farms."

The *Implementation Plan* describes the following approach to implementing this recommendation.

- Provide simplified back-up power systems and architecture that allows the Variable Frequency Drives (VFDs) and the basic process control system to be bypassed, thereby streamlining the current planned improvements related to emergency diesel generator systems, SS VFDs and SS control systems.

- Develop non-destructive examination methods to inspect the below grade ductwork.

- Complete the system interaction (two over one) evaluations.

- Eliminate single active failures in interfacing systems that could prevent operation of both primary tank ventilation system trains.

- Replace the existing AP and SY primary tank ventilation systems with the units that have been procured and are on site. Given that these units were procured as GS, the planned improvements discussed above are to be included in the activity.

Within this context, the *Implementation Plan* then defined Action 1-2 as:

> Develop a streamlined approach to implementing the planned improvements for upgrading the DST primary tank ventilation systems to meet SS requirements.

The associated deliverable was defined as:

> A report describing the executable strategy, cost, and schedule for upgrading each DST primary tank ventilation system to meet SS requirements. This process will be documented and will include an evaluation of the approach described above, including the simplified back-up power system and architecture.

Although this report focuses on Action 1-2 the other actions associated with Sub-Recommendation 1 are briefly summarized below.

- Action 1-1: Implement the DOE-approved DSA and associated Technical Safety Requirements (TSR)s for DST Primary Tank Ventilation Systems. This action is complete.

- Action 1-3: Develop a feasibility study for inspecting the condition and integrity of DST primary tank ventilation ductwork between the tank and flow monitoring locations. This action is being worked in parallel with Action 1-2 and will be addressed in a separate report.

- Action 1-4: Upgrade the remaining DST active ventilation systems to meet SS requirements. This action will be addressed through the implementation of the Action 1-2 proposal described herein.

2.0 PURPOSE

This document outlines a strategy for addressing Action 1-2 of the *Implementation Plan*. To maximize efficiencies while enhancing the ability to ventilate the DST headspace when needed to address flammable gas hazards, an alternative approach to streamlining the planned improvements for the existing primary tank ventilation systems is described herein. This approach proposes using portable exhausters with self-contained generator units to provide the necessary airflow when the flammable gas hazard exists and the DST primary tank ventilation system is inoperable. As noted previously, Action 1-4 will be completed through the implementation of this proposed plan for Action 1-2.

Other Sub-Recommendations and actions related to upgrades of DST primary tank ventilation system are outside of the scope of this report. Specifically, this report does not describe activities associated with Action 1-3, which is to develop a feasibility study for inspecting the condition and integrity of DST primary tank ventilation ductwork between the tank and flow monitoring locations; nor does it describe Sub-Recommendation 2 (Actions 2-1 through 2-4), which focus on the installation of SS instrumentation for real-time monitoring of the ventilation exhaust flow from each DST. In proposing the use of portable exhausters, however, it is assumed that the existing DST primary tank ventilation ductwork from the tank to the flow monitoring location will be inspected and is ready for use. It is also assumed that the SS flow monitoring instrumentation will be installed.

3.0 DST VENTILATION SYSTEM DESCRIPTION

DST primary tank ventilation systems are designed to provide a flow of air through the tank headspace that purges flammable gases generated and released from the tank waste. Other non-safety related functions of the DST primary tank ventilation systems include providing cooling of tank waste and limiting fugitive air emissions (i.e., radioactive material releases) in accordance with environmental permits. The 241-AN, 241-AP, 241-AW, and 241-SY tank farms each have a DST primary tank ventilation system, and there is one DST primary tank ventilation system (702-AZ) for the 241-AY and 241-AZ tank farms. The DST primary tank ventilation systems have redundant exhaust trains capable of providing airflow through the tank headspace.

4.0 DST PRIMARY TANK VENTILATION SYSTEM REQUIREMENTS

DST primary tank ventilation systems are currently GS Structures, Systems, and Components (SSC), but are identified as SS SSCs for flammable gas accidents in DSTs per the DSA (RPP-13033 Section 4.4.10).

4.1 SAFETY FUNCTION

The safety function of each DST primary tank ventilation system is to maintain the concentration of flammable gases below the LFL in the DST headspace from steady-state releases and induced gas release events (GRE) due to water additions, chemical additions, and waste transfers into DSTs. Maintaining the flammable gas concentration below the LFL protects the facility worker from a flammable gas deflagration in a DST.

4.2 FUNCTIONAL & PERFORMANCE REQUIREMENTS

A summary of the functional requirements for DST primary tank ventilation systems is provided below. For the complete description of these functional requirements refer to Section 4.4.10.3, "Functional Requirements," of the tank farms DSA.

The primary functional requirement of the DST primary tank ventilation systems is to provide sufficient tank headspace ventilation to maintain the concentration of flammable gas < 100% of the LFL from steady-state releases and induced GREs due to water additions, chemical additions, and waste transfers into DSTs.

The performance requirement for DST primary tank ventilation systems is to provide sufficient tank headspace ventilation to maintain the concentration of flammable gas ≤ 25% of the LFL from steady-state releases and induced GREs due to water additions, chemical additions, and waste transfers into DSTs.

The DST primary tank ventilation systems must meet the above functional and performance requirements for normal and off-normal conditions and events, including design basis natural phenomena (i.e., earthquakes [seismic events], high wind, volcanic ash fall, lightning, dust storms/dust devils, extreme temperatures, and precipitation/snow).

5.0 STREAMLINED APPROACH

When assessing the scope of this streamlining task, the project sought to:

1. Identify a strategy that ensures that ventilation is available when required to address flammable gas hazards (which meets the intent of upgrading the DST primary tank ventilation systems to SS).

2. Identify a strategy that meets the first objective above and maximizes cost effectiveness (recognizing that one of the primary reasons that limited progress has been made on the planned improvements to date is the high cost in a budget constrained environment).

The proposed streamlined approach, to use portable exhausters with self-contained generator units to provide the necessary airflow when the flammable gas hazard exists and DST primary tank ventilation system is inoperable, will require a shift in the control paradigm. The current paradigm is that the DST primary tank ventilation systems need to operate with high reliability continuously to address steady-state flammable gas hazards. The systems are currently accepted as GS (with associated Limiting Condition for Operation [LCO] that define operability and actions to be taken if the systems become inoperable) with a list of planned improvements to upgrade each system to meet SS requirements. As noted above, the cost and schedule associated with completing these planned improvements is significant. Under the new control paradigm an alternative source of ventilation is deployed when warranted by the flammable gas hazard. Upgrades to the existing ventilation systems would be limited to the installation of SS flow monitoring instrumentation (covered by Action 2-2) and inspections of the ductwork from the tank to the flow monitoring locations (with the potential for, as yet undefined, follow-on corrective actions).

As shown below, this report is responsive to the approach outlined in the *Implementation Plan* (text is reproduced from Section 1.0 with an explanation of how this proposal responds to each objective).

- Provide simplified back-up power systems and architecture that allows the VFDs and the basic process control system to be bypassed, thereby streamlining the current planned improvements related to emergency diesel generator systems, SS VFDs and SS control systems.

  The portable exhausters proposed herein have self-contained generators and simple controls systems. Thus, the intent is of this objective is met.

- Develop non-destructive examination methods to inspect the below grade ductwork.

  As noted previously, this activity (Action 1-3) is ongoing.

- Complete the system interaction (two over one) evaluations.

  Given that the portable exhauster will be used in situations where both trains of the applicable DST primary tank ventilation system are inoperable and there is a flammable gas hazard (i.e., concentration is > 25% of the LFL), the two over one evaluation will be completed for the portable exhausters. Thus, the intent of this objective (to protect the ventilation system that is addressing the flammable gas hazard) is met.

- Eliminate single active failures in interfacing systems that could prevent operation of both primary tank ventilation system trains.

  Portable exhauster will be used in situations where both trains of the applicable DST primary tank ventilation system are inoperable (from any cause) and there is a flammable gas hazard (i.e., concentration is > 25 % of the LFL). Thus, the intent of this objective is met.

- Replace the existing AP and SY primary tank ventilation systems with the units that have been procured and are on site. Given that these units were procured as GS, the planned improvements discussed above are to be included in the activity.

  The projects to install the new units in AP and SY farms as GS are proceeding. Planned improvements related to the ductwork from the tank to the flow monitoring location

(Action 1-3) and installation of SS flow instrumentation (Action 2-2) will be implemented for these systems.

5.1 FLAMMABLE GAS HAZARD

The flammable gas hazards that are relevant to this project (i.e., steady-state and induced GRE) are described below.

5.1.1 Steady-State

Under current waste storage configurations, the following steady-state flammable gas hazard scenario is plausible (i.e., it is possible to reach or exceed 100% of the LFL).

- A long term ventilation outage where flammable gas from steady-state generation accumulates to a concentration ≥ 100 % of the LFL.

  – Steady-state flammable gas accumulation has historically not been an issue for DSTs, because it only takes ~ 8 cfm to maintain flammable gas concentration ≤ 25 % of the LFL in the worst-case DST. In addition, empirical evidence indicates that the flammable gas concentration remained well under 25% of the LFL during a DST primary tank ventilation outage of > 100 days in the 241-AY/AZ farm.

- Therefore in an unforeseen condition where the steady-state hazard manifests itself, there is sufficient time to deploy the portable exhauster.

5.1.2 Gas Release Event

Under current waste storage configurations, the following induced GRE scenarios are plausible (i.e., it is possible to reach or exceed 100% of the LFL).

- A seismically-induced GRE can theoretically release enough retained flammable gas in some tanks to exceed 100% of the LFL. Ventilation cannot prevent this event, but it does reduce the time at risk. The seismically-induced GRE would potentially require the deployment of the portable exhauster to aid in reducing the flammable gas concentration in the DST headspace in the event of loss of primary tank ventilation.
- A waste transfer, large water addition, or chemical addition, which requires application of LCO 3.4, *DST Induced Gas Release Event Flammable Gas Control*, and is largely controlled by shutting down the waste transfer if the applicable DST primary tank ventilation system becomes inoperable.

5.2 ASSUMPTIONS

The assumptions listed below are fundamental to the implementation of the new paradigm (i.e., portable exhauster concept). It can be noted that Assumptions 7 and 8 specifically relate to the

DST primary tank ventilation systems and are key to implementing the daily operations aspect of the new paradigm. Several of the assumptions will be verified during the design process and may become requirements associated with the portable exhauster design and use.

1. Implementation of the new control paradigm in the tank farms safety basis will be approved by ORP. The fundamental change will be a reliance on the portable exhauster when the flammable gas hazard is present (i.e., flammable gas concentration > 25% of the LFL) and the applicable primary tank ventilation system is inoperable. The primary control would be implemented as follows (specific details will be determined in the amendment process).

   Deploy the portable exhauster when the flammable gas concentration reaches ~25% of the LFL and turn on the exhauster when flammable gas concentration reaches ~50% of the LFL, with an objective of staying < 60% of the LFL.

2. DST space will be managed such that the five-day time to 25% of the LFL will be retained and the required passive breathing rates to stay below 25% of the LFL remain low (currently < 8 cfm per TSR basis). This assumption ensures that there is significant time to respond to loss of ventilation.

3. Portable exhausters can be permitted without sophisticated sampling systems that drive costs upward, with the clear understanding that the portable exhausters would only be deployed when the flammable gas hazard is present. Section 5.4.3 contains the initial permitting requirements associated with the portable exhauster.

4. Operation of the portable exhausters after deployment would be limited to lowering the flammable gas concentration below 25% of the LFL at which point the exhauster would be turned off. In the event that the DST primary tank ventilation system was not operable, the portable exhauster would be restarted if the flammable gas concentration returns to elevated levels (i.e., the process would be repeated as necessary).

5. The HEPA filters (on the portable exhauster) will be analyzed post use for documenting exhauster emissions.

6. There is an available riser on each DST that is accessible and is able to be dedicated solely to this mission.

7. Ventilation duct work integrity is intact and sufficient to support daily operations (DNFSB IP Action 1-3 is currently looking at the feasibility of inspection). This assumption and assumption 8 below relate to the DST primary tank ventilation systems, which remain the first line of defense for addressing flammable gas hazards.

8. SS flow monitoring SSCs are installed and operational (DNFSB IP Action 2-2).

9. Permit conditions would allow for the deployment and operation of the portable exhausters.

5.3 CONCEPTUAL DESCRIPTION

TOC would procure multiple portable exhausters each with an on-board generator (exhauster and generator are seismically qualified) and store the units in a seismically qualified building or store outdoors using a restraint system and weather protection. Due to the redundancy of having multiple units (more than minimum number of required), the portable exhausters would be procured as GS with the exception of SS flow monitoring on portable exhausters. The portable exhausters would have preventative maintenance (PM) requirements to ensure each of the portable exhausters would be fully operable when called upon for deployment.

The portable exhauster conceptual design is shown below in Figure 1. The portable exhauster would connect to a dedicated riser on each DST (i.e., no connection to existing ductwork). The air stream would flow through a flexible duct into a flow element, which will measure the flow rate coming from the tank headspace. The air stream would then flow into a baffle, which would be used to collect condensate prior to filtration. The condensate would be directed back to the tank via the dedicated riser connection. The air stream would then flow through a multi-stage HEPA filters that will be analyzed post use. The air stream would pass through the air moving device (e.g., fan) and finally be discharged out a stack. The portable exhauster power is provided by a small commercially available generator.

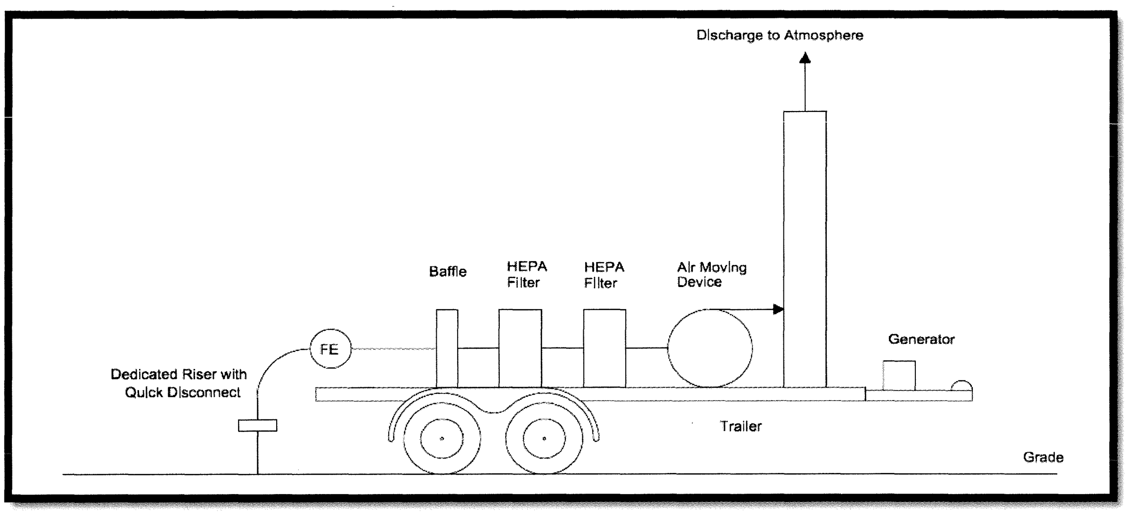

Figure 1. Portable Exhauster Concept

5.4 CONCEPTUAL DESIGN REQUIREMENTS

The requirements listed below reflect initial conceptual design requirements. These requirements are subject to change during the detailed design process.

5.4.1 DST System Interface Requirements

REQ-1 The minimum flow rate per tank shall be greater than 8 cfm. Required tank exhaust airflow to maintain the flammable gas concentration ≤ 25% of the LFL for steady-state releases and slow, continuing induced gas releases following water additions, chemical additions, and waste transfers into DSTs ranges from approximately a minimum of 1 to < 8 cfm for the 28 DSTs.

REQ-2 Existing risers will be dedicated for the portable exhausters and will be available for use.

REQ-3 Condensate will be directed back to the DST being ventilated.

REQ-4 The portable exhauster will have the capability to plug into other power source (generator or permanent source).

5.4.2 Portable Exhauster Requirements

REQ-5 HEPA filters will be designed to be in-place challenge tested in accordance with ASME AG-1, Section TA and ASME N510, as applicable.

REQ-6 The natural conditions (e.g., weather) in which the ventilation equipment will be subjected to, and be designed to operate in, are identified in TFC-ENG-STD-02, Environmental/Seasonal Requirements.

REQ-7 Flexible ductwork will be designed, fabricated, installed and tested in accordance with ASME B31.3, Process Piping.

REQ-8 Isolation and control valves/dampers will meet the appropriate requirements of ASME B31.3 and ASME B16.34, Valves Flanged, Threaded and Welding End.

REQ-9 The exhaust fan will be certified and meet the requirements of ANSI/AMCA 210, Laboratory Methods of Testing Fans for Aerodynamic Performance Rating, for fan performance.

REQ-10 The portable ventilation system stack height will sufficiently disperse the exhaust gases to satisfy the Washington State Department of Health (WDOH) and the Washington State Department of Ecology (WS DOE).

REQ-11 Design will consider applicable ventilation requirements per TFC-ENG-STD-07, *Ventilation System Design Standard.*

REQ-12 Design will consider applicable ignition controls per TFC-ENG-STD-13, *Ignition Source Control Evaluation.*

5.4.3 Permitting Requirements

The WDOH has indicated that the portable exhauster is a viable option. TOC met with WDOH and suggested that permitting of the systems be completed under a categorical permit, which would require an independent log for each portable exhauster system and notification to WDOH of when each unit was constructed. Once final design is complete, work on the permit would be initiated and actual construction would be dependent upon acquisition of the permit. It should be noted that WDOH stated that the portable exhauster concept would be outside of the standard considerations due to the frequency of the emergency (accident scenario).

A similar discussion took place with WS DOE. The meeting highlighted requirements associated with the on-board generator and potential emissions of concern. The requirements listed below reflect the conceptual design requirements associated with environmental permitting.

<u>REQ-13</u> WDOH regulations address frequencies of less than 1 in 100 years. The frequency of events where exhausters would be deployed are estimated to be at least "unlikely" by Nuclear Safety and meet this requirement.

<u>REQ-14</u> An independent log for each portable exhauster and notification to WDOH will be maintained and updated when each unit is constructed.

<u>REQ-15</u> The permit application will contain a detailed description of the scenarios in which the portable exhauster will be used.

<u>REQ-16</u> The portable exhaust system will have a means to perform exhaust sampling (i.e. HEPA filters analyzed post use).

<u>REQ-17</u> The portable exhauster generators will meet the applicable performance standards based on size.

<u>REQ-18</u> TOC will submit an application to WS DOE to permit the portable exhauster units.

<u>REQ-19</u> Final design will be submitted to WDOH and WS DOE for review.

5.4.4 Operational Requirements

<u>REQ-20</u> Notification must be made to the WDOH prior to use.

<u>REQ-21</u> PM program will be established and operational.

<u>REQ-22</u> Refueling will be completed per TFC-ESHQ-FP-STD-03, *Flammable/Combustible Liquids.*

<u>REQ-23</u> Field deployment technique (e.g., vehicle) will be available post-seismic event.

5.4.5 Applicable Codes and Standards

The portable exhauster units will be designed and operated in accordance with the applicable following codes, standards, and industry best practices to the extent practical. The list below is not all inclusive and the codes or standards may not be used in their entirety.

- 40 CFR 60, *Protection of the Environment – Standards of Performance for New Stationary Sources* (App. A, as applicable)
- ASME AG-1, *Code on Nuclear Air and Gas Treatment*
- ASME N509, *Nuclear Power Plant Air-Cleaning Units and Components*
- ASME N510, *Testing of Nuclear Air Treatment Systems*
- ASME N511, *In-Service testing of Nuclear Air Treatment Systems*
- ASME NQA-1, *Quality Assurance Requirements for Nuclear Facility Applications*
- NFPA 69, *Standard on Explosion Prevention Systems*
- NFPA 70, *National Electrical Code*
- NFPA 101, *Life Safety Code*

5.5 LOGISTICS

To determine the required number of portable exhausters, existing data for both GRE and steady-state flammable gas hazards was considered. Applying the gas release fraction of 50% from a DST during a design basis seismic event that was estimated by Pacific Northwest National Laboratory to the headspace flammable gas concentrations calculated using the most recent revision (Rev. 12) of RPP-10006, *Methodology and Calculations for the Assignment of Waste Groups for the Large Underground Waste Storage Tanks at the Hanford Site*, it was concluded that six DSTs could theoretically reach greater than 100% of the LFL in a seismic event. Note that one of the six DSTs is predicted to reach ~90% of the LFL, but it was conservatively included for this exercise. With respect to steady-state flammable gas hazards there are two DSTs that can reach 25% of the LFL in a short time frame (≤ 10 days, using engineering judgment), assuming no ventilation as depicted in Table 7-8 of RPP-5926 (Rev. 14), *Steady-State Flammable Gas Release Rate Calculation and Lower Flammability Level Evaluation for Hanford Tank Waste*. While it is not likely that a seismic event would cause a DST to become hermetically sealed, it will conservatively be assumed (for this exercise only) that it is a common cause event. Ten portable exhausters would be constructed, maintained, and available for use based on the logic shown below.

2 (steady-state) + 6 (seismically induced GRE) + 2 spare = *<u>10 Portable Exhausters</u>*

5.5.1 Deployment Strategy

Deployment of exhausters would be completed per an emergency response plan and TSR Action statements. The high-level sequence of activities may consist of those listed below in Figure 2.

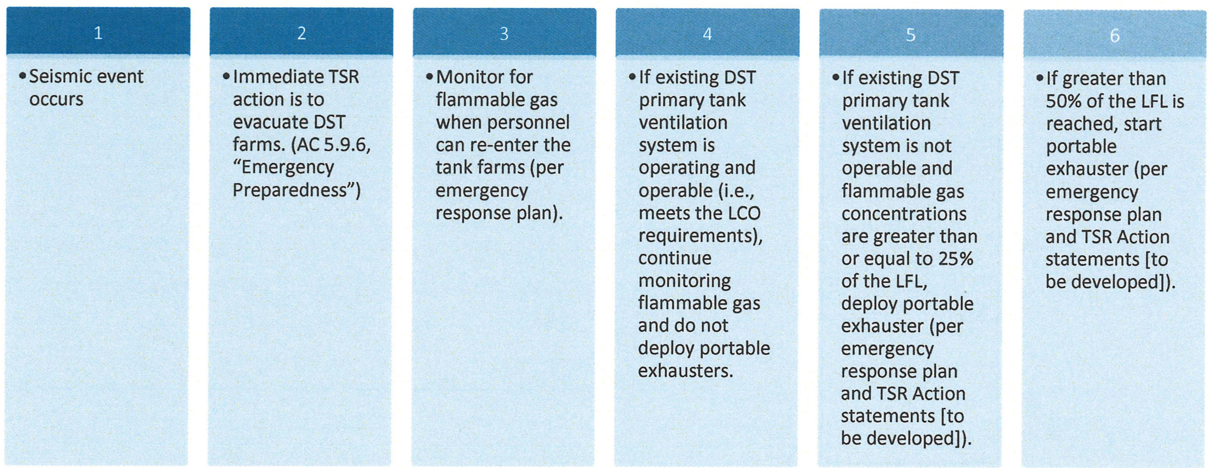

Figure 2. Deployment Strategy

6.0 PLANNED IMPROVEMENT DISPOSITIONS

The planned design and operational safety improvements have been identified from the system evaluation of the SS DST primary tank ventilations systems and are described in Section 3.3.2.3.5, "Planned Design and Operational Safety Improvements," of the tank farms DSA. The proposed disposition of these planned improvements, based on the strategy described herein is shown below in Table 1.

Table 1. Planned Improvement Dispositions

ID	Planned Improvement	Disposition
A	Electrical power is required for the DST primary tank ventilation systems to perform their safety function and, therefore, electrical power is a safety-significant support system. Because upgrading the existing electrical power supply and distribution system to safety significant is not feasible, a safety-significant backup diesel generator system will be installed to provide electric power for each of the five DST primary tank ventilation systems (i.e., total of five backup diesel generator systems). The backup diesel generator systems will be installed and operational 22 months following ORP authorization to proceed.	This planned improvement is no longer needed based on the new control paradigm.
B	Safety-significant instrumentation will be installed to	Addressed by Action 2-2

	monitor the exhaust airflow from each DST. This tank exhaust airflow instrumentation will replace the periodic manual measurement of tank exhaust airflow and reliance on tank pressure (vacuum) instrumentation to verify that the DST primary tank ventilation system trains are operable and operating (i.e., providing sufficient tank headspace ventilation to maintain the concentration of flammable gas ≤ 25% of the LFL). The tank exhaust airflow instrumentation will be installed and operational 32 months following ORP authorization to proceed.	which is funded and ongoing.
C	The system evaluations of the DST 241-AN and 241-AW tank farm primary tank ventilation systems, because of the limited time allowed for the evaluations, were not able to document verification of how the functional/performance design requirements established for safety-significant DST primary tank ventilation systems are met for the conditions and events in which their safety function must be met. The system evaluation will be revised to provide the basis for compliance with the functional/performance design requirements or will identify the need for additional planned improvements. The revised system evaluation will be completed 12 months following ORP authorization to proceed. (See also Design/Operational Improvement E.)	This planned improvement is no longer needed based on the new control paradigm.
D	Upgrades are planned for the DST 241-AP, 241-AY/241-AZ, and 241-SY tank farm primary tank ventilation systems. These DST primary tank ventilation system upgrades will replace or address all existing ventilation system components, with the exception of the below grade ductwork. These planned upgrades are the basis for not documenting verification of how the existing DST 241-AP, 241-AY/241-AZ, and 241-SY tank farm primary tank ventilation systems meet the functional/performance design requirements established for safety-significant DST primary tank ventilation systems for the conditions and events in which their safety function must be met. The existing DST 241-AP, 241-AY/241-AZ, and 241-SY tank farm primary tank ventilation systems will be required to meet the technical safety requirements established to ensure their operability and operation. The planned upgrades of the DST 241-AP, 241-AY/241-AZ, and 241-SY tank farm primary tank ventilation systems will be completed in accordance with the approved Project schedules as amended to incorporate this planned improvement. Note: The planned upgrades of the DST 241-AP, 241-	This planned improvement is no longer needed based on the new control paradigm. The plan is to install previously procured and constructed exhauster skids as GS in AP and SY Farms. There is no current plan to replace the AY/AZ ventilation system.

	AY/241-AZ, and 241-SY tank farm primary tank ventilation systems will address the design issues identified by the system evaluations of the existing ventilation systems (see Section 4.4.10), except for below grade ductwork (see Design/Operational Improvement E).	
E	The DST primary tank ventilation system below grade ductwork was not replaced in the recent upgrades of the DST 241-AN and 241-AW tank farm primary tank ventilation systems and will not be replaced in the planned upgrades of the DST 241-AP, 241-AY/241-AZ, and 241-SY tank farm primary tank ventilation systems. The system evaluations of the below grade ductwork for the five safety-significant DST primary tank ventilation systems could not demonstrate compliance with the functional/performance requirements due to potential degradation/deterioration from corrosion. An evaluation of the integrity of below grade DST primary tank ventilation system ductwork will be performed as a planned improvement. The results of the evaluation will be completed 24 months following ORP authorization to proceed and will (1) provide the basis for compliance with the functional/performance requirements, (2) establish in-service inspections/tests or controls (e.g., vehicle load restrictions) required to ensure the safety function is met, and/or (3) identify planned improvements to replace the below grade DST primary tank ventilation system ductwork.	A feasibility report for this inspection is ongoing as a part of Action 1-3.
F	DOE-STD-1021-93, Natural Phenomena Hazards Performance Categorization Guidelines for Structures, Systems, and Components, requires an evaluation of system interaction effects ("two over one protection") from natural events (e.g., earthquakes [seismic events], high winds). The system interaction evaluation of the existing DST 241-AN and 241-AW primary tank ventilations systems and of the upgraded DST 241-AP, 241-AY/241-AZ, and 241-SY tank farm primary tank ventilation systems will be performed in conjunction with Design/Operational Improvements C and D, respectively. The system interaction evaluation will identify the SSCs whose failure from a natural event could have an adverse interaction with the DST primary tank ventilation systems. The identified SSCs will either be designated safety significant to prevent the adverse interaction or planned improvements will be identified to eliminate the adverse interactions. The system interaction evaluation for the existing DST 241-AN and 241-AW primary tank	This planned improvement is no longer needed based on the new control paradigm. The scope would be limited to evaluating the portable exhauster storage and deployment environments.

	ventilations systems will be completed 12 months following ORP authorization to proceed. The system interaction evaluation for the upgraded DST 241-AP, 241-AY/241-AZ, and 241-SY tank farm primary tank ventilation systems will be completed in accordance with the approved Project schedules as amended to incorporate this planned improvement.	
G	The existing variable frequency drives (VFD) for the DST 241-AN and 241-AW primary tank ventilation system train exhaust fan motors are required to be safety significant, but are currently designated general service. An evaluation and documentation is required to establish and verify compliance with the critical design, material, and performance characteristics necessary to ensure the safety-significant VFDs will perform their safety function. The evaluation will also identify any safety-significant support systems needed to maintain the environmental conditions (e.g., temperature, humidity) required for the VFDs to perform their safety function. The evaluation and documentation required to designate the DST 241-AN and 241-AW primary tank ventilation system VFDs safety significant will be completed 12 months following ORP authorization to proceed.	This planned improvement is no longer needed based on the new control paradigm.
H	The control systems for the DST 241-AN and 241-AW primary tank ventilation systems are required to be safety significant, but are currently designated general service. Because qualifying the existing control systems as safety significant is not feasible, there are planned improvements to install upgraded control systems that are safety significant. The existing general service exhaust stack flow and temperature instrumentation, which are support systems required to control the exhaust fan motor VFDs, will also be replaced with safety-significant systems as part of the control system upgrades. In addition, the planned control system upgrades will identify any safety-significant support systems needed to maintain the environmental conditions (e.g., temperature, humidity) required for the control systems to perform their safety function. The planned upgrades of the DST 241-AN and 241-AW tank farm primary tank ventilation control systems will be completed in accordance with the approved Project schedules as amended to incorporate this planned improvement.	This planned improvement is no longer needed based on the new control paradigm. The portable exhauster would be connected directly to the tank and not utilize the existing primary tank ventilation system.
I	Design improvements are required to eliminate single active failures in interfacing systems that could prevent operation of both the DST 241-AN and 241-AW primary	This planned improvement is no longer needed based on the new control paradigm.

	tank ventilation system trains. These single active failures are identified in the system evaluation of the DST primary tank ventilation systems. The functional requirement of no single active failure in interfacing systems ensures the reliability of the DST primary tank ventilation systems. The following design improvement is planned. Failures of DST 241-AN and DST 241-AW tank pressure (vacuum) instrumentation shut down both ventilation system trains. A design improvement to eliminate these single active failures will be completed 36 months following ORP authorization to proceed.	The portable exhauster would be connected directly to the tank and not utilize the existing primary tank ventilation system.
J	An upgrade of the existing predictive maintenance program for vibration monitoring of the DST primary tank ventilation system exhaust fans and motors is planned as an operational improvement. The upgrade, which will include new vibration monitoring equipment and training, will increase the confidence for determining the operability of a DST primary tank ventilation system train and should also increase system availability. The planned upgrade of the vibration monitoring predictive maintenance program will be completed 12 months following ORP authorization to proceed.	This planned improvement is not addressed in scope of Action 1-2. However, it will be address via the reliability and predictive maintenance program.

7.0 PORTABLE EXHAUSTER CONCEPT ROM ESTIMATES

The portable exhauster rough order of magnitude (ROM) estimates for cost and schedule are based on the items listed below. The estimated cost and schedule at a ROM level for the portable exhauster units are $10.8 million and 20 months respectively.

- Project Management activities, which consist of the Project Manager, Project Engineer, and Project Controls personnel.
- Engineering activities, which consist of fabrication drawings, engineering change notices, specifications, analysis, a DSA amendment, and a TSR revision.
- Procurement of the portable exhauster, riser modification parts, and the storage facility.
- Field work activities, which consist of planning and facility modifications.
- Startup/Testing/Turnover activities, which include new and updated procedures, training, factory acceptance testing, operation acceptance testing, and operation readiness activities.

8.0 BENEFITS & RISKS

The following sections discuss the benefits and risks associated with the portable exhauster concept.

8.1 BENEFITS

The proposed use of portable exhausters offers the following benefits.

- Significant cost and schedule savings (reduction of cost from approximately $120 million).
  - Therefore the proposal is more likely to be implemented in a timely fashion vs. upgrades to existing systems.
  - Overall field work associated with the planned improvements would be drastically decreased, which would aid in meeting As Low AS Reasonably Achievable (ALARA) goals.
- Significant enhancement to safety basis control strategy.
  - Current LCO provides high level guidance when flammable gas concentration > 25% of the LFL. Ultimately ends with Recovery Plan if the flammable gas concentration > 60% of the LFL.
  - Under this proposal, LCO action would be very specific (deploy portable exhauster then operate if warranted by flammable gas concentration) and the reliance on the Recovery Plan is obviated.
- The strategy is consistent with long term plans to operate mixer pumps. Overall strategy for operating mixer pumps (as developed for AY-102 mixer pump test which has been suspended) relies on SS interlocks.
  - Interlock 1: SS flow indication to shutdown mixer pumps when ventilation low flow alarm condition reached.
  - Interlock 2: SS temperature monitoring system to shutdown mixer pumps when predetermined DST-specific temperature limit is reached.
  - There is no additional Nuclear Safety burden on the DST primary tank ventilation system. Burden on ventilation system is mission driven (i.e., require sufficient reliability and cooling capacity to allow mixer pumps to run for required period of approximately 10 days without tripping on high temperature).

8.2 RISKS

The risks listed below in Table 2 are associated with pursuance of the portable exhauster and are high level in nature.

Table 2. Potential Risks

ID	Risk	Impact	Probability	Mitigation
1	Access to the tank risers (above tank) post-seismic event due to structural conditions is questionable.	High	Low	Design portable exhauster tie-in such that it does not require access to the top of the tank.
2	Changes in permitting and regulation requirements from WDOH and WS DOE.	Medium	Medium	Ensure that both WDOH and the WS DOE engaged throughout the design, procurement, and fabrication of the portable exhausters.
3	Changes in DOE and/or TOC procedures, standards, and codes.	Medium	Medium	Ensure that DOE is engaged and fully aware of project status.
4	A significant follow-on event (seismic) compromises integrity of deployed portable exhausters.	High	Medium	Design appropriate controls or features to ensure integrity. Increase the number of portable exhausters to account for such an event.

9.0 REFERENCES

40 CFR 60, *Protection of the Environment – Standards of Performance for New Stationary Sources*, Environmental Protection Agency.

American Nation Standards Institute/Air Movement and Control Association, *Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating,* ANSI/AMCA 210.

American Society of Mechanical Engineers, *Code on Nuclear Air and Gas Treatment,* ASME AG-1.

American Society of Mechanical Engineers, *In-Service testing of Nuclear Air Treatment Systems,* ASME N511.

American Society of Mechanical Engineers, *Nuclear Power Plant Air-Cleaning Units and Components,* ASME N509.

American Society of Mechanical Engineers, *Process Piping*, ASME B31.3.

American Society of Mechanical Engineers, *Quality Assurance Requirements for Nuclear Facility Applications,* ASME NQA-1.

American Society of Mechanical Engineers, *Testing of Nuclear Air Treatment Systems,* ASME N510.

American Society of Mechanical Engineers, *Valves Flanged, Threaded and Welding End,* ASME B16.34.

DNFSB Recommendation 2012-2, *Hanford Tank Farms Flammable Gas Safety Strategy*, dated September 28, 2012.

DOE Response to Recommendation 2012-2, dated January 7, 2013.

DOE Implementation Plan for Defense Nuclear Facilities Safety Board Recommendation 2012-2, *Hanford Tank Farms Flammable Gas Safety Strategy*, dated June 6, 2013.

DOE-STD-1021-93, Natural Phenomena Hazards Performance Categorization Guidelines for Structures, Systems, and Components, April 2002.

National Fire Protection Association, *Standard on Explosion Prevention Systems,* NFPA 69.

National Fire Protection Association, *National Electrical Code,* NFPA 70.

National Fire Protection Association, *Life Safety Code*, NFPA 101.

RPP-10006, 2013, *Methodology and Calculations for the Assignment of Waste Groups for the Large Underground Waste Storage Tanks at the Hanford Site,* Rev. 12, Washington River Protection Solutions LLC, Richland, Washington.

RPP-13033, 2014, *Tank Farms Documented Safety Analysis*, Rev. 5-G, Washington River Protection Solutions LLC, Richland, Washington.

RPP-5926, 2014, *Steady-State Flammable Gas Release Rate Calculation and Lower Flammability Level Evaluation for Hanford Tank Waste*, Rev. 14, Washington River Protection Solutions LLC, Richland, Washington.

TFC-ENG-STD-02, *Environmental /Seasonal Requirements for TOC System, Structures, and Components,* Washington River Protection Solutions LLC, Richland, Washington.

TFC-ENG-STD-07, *Ventilation System Design Standard,* Washington River Protection Solutions LLC, Richland, Washington.

TFC-ENG-STD-13, *Ignition Source Control Evaluation*, Washington River Protection Solutions LLC, Richland, Washington.

TFC-ESHQ-FP-STD-03, *Flammable/Combustible Liquids,* Washington River Protection Solutions LLC, Richland, Washington.