Department of Energy
Washington, DC 20585

DEC 24 2009

MEMORANDUM FOR SHIRLEY OLINGER
MANAGER
OFFICE OF RIVER PROTECTION

FROM: DR. STEVEN L. KRAHN
ACTING DEPUTY ASSISTANT SECRETARY FOR
SAFETY AND SECURITY PROGRAM
ENVIRONMENTAL MANAGEMENT

SUBJECT: Evaluation of the 242A Evaporator Facility Ventilation System in Response to Defense Nuclear Facilities Safety Board Recommendation 2004-2, Final Report

During a Department of Energy (DOE), Environmental Management (EM) Technical Authority Board (TAB) meeting on November 16, 2009, the Defense Nuclear Facilities Safety Board (DNFSB) reviewed an initial version of the subject report. Since the report had not been accomplished against Safety Significant review criteria, the TAB requested that DOE, Office of River Protection (ORP) revise the report.

Based on review of the information included in the subject revised report, evaluation by the DNFSB 2004-2 Independent Review Panel, the EM TAB, and input from the Chief of Nuclear Safety Office, the report is approved with the following considerations.

- The gap identified with respect to DOE-STD-1066 will be further evaluated upon receipt of a revision to the revised Fire Hazard Analysis and a determination made if the ORP approval will be required for any associated equivalency(s) and/or exemption(s).

If you have any further questions, please call me at (202) 586-5151.

Attachments

cc:
D. Chung, EM-2
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INDEPENDENT REVIEW

OF

Office of River Protection
242-A Evaporator
Ventilation System Evaluation Report

December 2009

Executive Summary

The Defense Nuclear Facility Safety Board (DNFSB) Recommendation 2004-2 Independent Review Panel (IRP) reviewed Richland Operations Office Hanford Site 242-A Evaporator Facility Ventilation System Evaluation Report utilizing the process and criteria outlined in Department of Energy's *Ventilation System Evaluation Guidance for Safety-Related and Non-Safety-Related System* (2004-2 Ventilation System Evaluation Guide).

The 242-A Evaporator is designed to reduce waste volume and the number of Double Shell Tanks (DSTs) required to store liquid waste generated at the Hanford Site. The process uses a conventional, forced-circulation, vacuum evaporation system operating at low pressure and low temperature to concentrate radioactive waste solutions. The 242-A Evaporator has active ventilation systems. The ventilation systems work in concert with the facility floor plan (zones) to direct airflow from areas of lesser contamination potential to areas of greater contamination potential. Airlocks separate potentially contaminated areas from non-contaminated areas. Exhaust air passes through a cleanup system consisting of two stages of HEPA filters. The 242-A Evaporator is a Hazard Category 2 nuclear facility. The ventilation system has been classified as defense in depth.

The Facility Evaluation Team (FET) performing the ventilation system evaluation reviewed the functional classification of the system and concluded that it was correctly classified as defense in depth. As a Hazard Category 2 nuclear facility, however, the 242-A Evaporator Facility Ventilation System was correctly evaluated against the Safety Significant level as specified in the 2004-2 Ventilation System Evaluation Guide. Two gaps were identified.

The IRP concludes that the ventilation systems evaluation was performed in accordance with the criteria in the DNFSB 2004-2 Ventilation System Evaluation Guide.

Results of Independent Review Panel's Review of the Office of River Protection (ORP) 242-A Evaporator Ventilation System Evaluation Report

1. INTRODUCTION

The Defense Nuclear Facility Safety Board (DNFSB) Recommendation 2004-2 Independent Review Panel (IRP) reviewed the Office of River Protection 242-A Evaporator Ventilation System Evaluation Report utilizing the process and criteria outlined in Department of Energy's (DOE's) *Ventilation System Evaluation Guidance for Safety-Related and Non-Safety-Related System* (2004-2 Ventilation System Evaluation Guide).

As stated in Revision 1 of the DNFSB Recommendation 2004-2 Implementation Plan, the focus of the ventilation system evaluation is to:

- Verify that appropriate performance criteria are derived for ventilation systems
- Verify that these systems can meet the performance criteria, if applicable, and
- Determine if any physical modifications are necessary to enhance safety performance.

The IRP team reviewed the ORP 242-A Evaporator Ventilation System Evaluation Report to determine whether it was performed in accordance with the 2004-2 Ventilation System Evaluation Guide; evaluate the appropriateness of the evaluation results and methods proposed for eliminating identified gaps, if any, between the existing ventilation system and applicable performance criteria; and provide any additional input considered appropriate to the responsible program and site offices.

2. FACILITY AND VENTILATION SYSTEM OVERVIEW

The K1 ventilation system services contaminated areas of the 242-A Building. Provisions are required to maintain confinement pressure differentials within the facility and to ensure that discharges of radioactive materials meet applicable regulations. The K1 exhaust stream is HEPA filtered, monitored for the presence of radioactive materials, and sampled to ensure that release limits are not exceeded.

The K1 ventilation system performs two safety functions: (1) maintains contaminated areas at a negative pressure relative to atmospheric and (2) filters and monitors exhaust air to ensure releases of radioactive and hazardous materials are within guidelines and ALARA.

The K1 ventilation system is a once-through air system. The K1 supply fan supplies outside air throughout the ventilated areas. Negative air pressure is maintained in K1 serviced areas. Air is drawn through two parallel two-stage HEPA filter enclosures and discharged through an elevated stack by one of two K1 exhaust fans. The discharge stack

is equipped with stack sampling system record sampler and Continuous Air Monitor (CAM). The exhaust portion of the K1 ventilation system consists of exhaust ducts that draw the air out of the various areas served by the K1 system. The exhaust ducts join at a common header that serves as the inlet to the two HEPA units. Each HEPA filter in the units is provided with a differential pressure instrument to monitor the condition of the filter. The exhaust fans are powered from a motor control center that can receive backup power from a diesel generator. The K1 system contains sufficient instrumentation to monitor and control air flows and the required negative pressures of specified compartments. Monitoring instrumentation includes exhaust air radioactivity detection and alarm. In addition, instrumentation provides controls and interlocks of critical components to initiate operation of the standby unit in the event of failure of the operating component.

The 242-A Evaporator has been in operation for 30 years. The facility is expected to continue with service for many more years. Evaporator upgrades have been identified which will extend the life of the facility to support the mission. One such upgrade involved the K1 exhaust system. The K1 exhaust system has provided building ventilation and contamination control since the 1970s. Several components of this exhaust system will be replaced as part of an ongoing facility life extension program. The K1 exhaust upgrade will be conducted as part of the overall Tank Farm ARRA project. Upgrades to the supply side of the K1 system were conducted and completed during Phase I in fiscal years 2007 and 2008.

The K1 exhaust system upgrade replaces all exhaust equipment downstream of the underground ventilation duct. The underground duct, not part of the scope of the modification is comprised of 4 sections that connect to a single inlet manifold header. This header is located north of the evaporator room. The upgrade involves design and procurement of all major components excluding the inlet manifold header. These components will be assembled and factory acceptance tests conducted. Once work is completed at the 242-A Evaporator to install all components of the K1 exhaust upgrade, operational acceptance tests will be performed by Washington River Protection Solutions. In addition to component upgrades, modifications will include the addition of a fire screen to the inlet duct, a third HEPA housing, and changing the HEPA filter instrumentation design from the use of separate pressure switches (for control room alarms) and pressure indicators (for local indication) to a single combined pressure differential indicator transmitter which indicates locally and sends a signal to the remote monitoring and control system.

The active K1 confinement ventilation system in the 242-A Evaporator is functionally classified as general service.

3.0 REVIEW RESULTS

3.1 Derivation of Ventilation System Performance Criteria and Confinement Strategy

The FET performing the system evaluation, reviewed determination of bounding unmitigated consequences presented in the DSA and concluded that the quantitative dose consequences were determined in accordance with DOE-STD-3009-94 and do not challenge the DOE-STD-3009-94 evaluation guideline. The ventilation system is not credited for reducing event consequences to a lower risk bin. The control suites identified in the DSA focus on preventive measures and inventory limits as well as the secondary containment systems such as the process cell in lieu of the ventilation system. The FET concluded that the ventilation systems associated with the 242-A Evaporator System are appropriately classified as defense in depth.

The IRP concluded that the ORP FET appropriately reviewed the safety classification of the ventilation system as specified in the 2004-2 Ventilation System Evaluation Guide.

3.2 Evaluation of Ventilation System Against the Selected Performance Criteria

The ORP FET ventilation report evaluated the 242-A Evaporator building confinement ventilation systems utilizing safety significant performance category 2 criteria from the 2004-2 Ventilation Evaluation Guide. The Report provides a systematic evaluation of the existing ventilation system against the 2004-2 performance criteria to identify any gaps along with a subsequent evaluation to evaluate potential remaining gaps post life extension upgrades. .

Two gaps were identified that will remain. Fire suppression features have not been provided inside HEPA filter housing as recommended by DOE-STD-1066, *Fire Protection Design Criteria*, and following modification the underground duct work may be vulnerable to a seismic event. The ventilation system is not credited in the DSA to operate or maintain confinement integrity during or following any DBA or NPH events.

3.3 Evaluation of physical modifications to enhance safety performance

2004-2 Ventilation System Evaluation Guide specifies that an evaluation of physical modifications that may be appropriate to enhance the ventilation system in the areas where the current confinement ventilation system does not meet the 2004-2 evaluation criteria should be performed.

A cost/benefit analysis was not performed to replace the underground ducting due to the extensive nature of the modification and the fact that addressing the gap would provide limited, if any, overall dose reduction. With respect to fire protection of the filter housing, a revision to the FHA will document any gaps with DOE-STD-1066 and ORP approval will be required for any associated equivalency(s) and/or exemption(s). A rough order of magnitude cost estimate was performed for adding a deluge system to the

planned modification. The design and installation was estimated at $1.1 M which does not include costs for cold weather protection and the significantly increased lifecycle cost for surveillance of the system. Additionally, a deluge system will introduce the potential for flooding from inadvertent system activation or leaks, and worker exposure from routine operations to maintain the deluge system. The FET does not recommend any changed to the planned modification.

4. CONCLUSIONS

IRP concludes that the ORP 242-A Evaporator ventilation system evaluation was performed in accordance with the criteria in the DNFSB 2004-2 Ventilation System Evaluation Guide.

5. RECOMMENDATIONS

The IRP recommends that the Program Secretarial Office and Central Technical Authority accept the ORP 242-A Evaporator dependent upon future approval of a resolution that addresses fire safety requirements for HEPA filter housings.

6. REVIEW TEAM MEMBERS

James O'Brien, IRP Chairman
Robert Nelson; IRP Member EM

Note: The IRP has established a review process that includes an initial review by two members of the IRP to determine whether the evaluation: (1) is consistent with the implementation plan methodology and expectations (including choice of evaluation criteria) and (2) was performed and documented with an appropriate level of detail and rigor.

A detailed-full IRP team review will be performed if the ventilation evaluation report is not consistent with the implementation plan, was not performed with an appropriate level of detail or rigor (after consultation with the report developers), or has unique ventilation strategies, gap analysis, or corrective actions that warrant full IRP review.

For this evaluation, a detailed-full IRP team review was not determined to be necessary.

Hanford Site 242-A Evaporator Facility

DNFSB Recommendation 2004-2 Ventilation System Evaluation

RPP-RPT-43806 Revision 0

E. Rensink

Date Published
November 2009

washington **river**
protection *solutions*

Prepared for the U.S. Department of Energy
Office of River Protection

Contract No. DE-AC27-08RV14800

Review and Approval

Facility Evaluation Team Concurrence:

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11/20/09

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Date

EXECUTIVE SUMMARY

This confinement ventilation system evaluation is for the 242-A Evaporator Facility at the Hanford Site. This evaluation was developed in accordance with the Department of Energy (DOE) evaluation guidance for Defense Nuclear Facility Safety Board (DNFSB) Recommendation 2004-2. This evaluation included the existing K1 Exhaust ventilation system and the K1 Exhaust ventilation system following proposed K1 Exhauster upgrade (Reference 2) that will replace several components of the existing system.

The 242-A Evaporator Facility is classified as Hazard Category 2, as given in Section 3.3.2.2 of the Documented Safety Analyses (DSA) Reference 1. The 242-A Evaporator K1 ventilation system is functionally classified as general service. This functional classification is based upon the low radiological and chemical consequences to both the 100-meter on-site and off-site receptors from the postulated evaporator events, as evaluated in the DSA, for the evaporator facility.

The 242-A Evaporator Hazard and Accident Analysis presented in Chapter 3 of the DSA, identified and analyzes three events at the evaporator to determine the potential worst case consequences from 242-A Evaporator activities. These events are:

- SPILL – a spill from a seismic event or other initiator that collapses the 242-A Building structure damaging the evaporator cell cover block and causing it to fall on the C-A-1 vessel releasing its contents.
- FIRE – a fire from an unidentified initiator ignites the combustibles in the evaporator room causing gaskets to fail and spray slurry onto the fire boiling the slurry and dispersing the contaminated steam.
- DEFLAGRATION or DETONATION – flammable gas accumulates in the evaporator headspace with an ignition source present resulting in a deflagration or detonation that releases evaporator contents

These three events bound the risk and consequences for all planned and unplanned 242-A Evaporator events postulated in Chapter 3. The unmitigated accident analyses assumed a Leak Path Factor of 1.0 and were performed assuming no active or passive confinement ventilation systems. The DSA does not identify any hazard events, including Natural Phenomena Hazard (NPH) events that need to have the evaporator active confinement ventilation system (or any passive ventilation) credited as Safety Class (SC) or Safety Significant (SS) controls. The active confinement ventilation systems for the Evaporator Facilities are not required to be SC or SS due to low radiological and chemical consequences to both the on-site and off-site receptors from the postulated events.

In accordance with the DOE 2004-2 evaluation guidance as requested by ORP, Washington River Protection Solutions (WRPS) evaluated the active K1 ventilation system at the 242-A Evaporator Facility using the SS criteria defined in Table 5.1 based on the Hazard Category 2 inventory levels. To assess functionality for applicable NPH events, PC-2 criteria were used. Three gaps were identified between the SS criteria and the existing system. An upgrade to the K1 exhaust is planned. Following the planned modification, only two gaps were identified between the SS criteria and the expected ventilation system design.

The first gap following the planned modification being that the underground ductwork may not withstand a seismic event was discretionary and modifications to address these gaps would provide limited, if any, overall dose reduction, a cost/benefit analysis was not performed to replace the underground ducting.

The second gap being that the proposed modification does not include provision for a deluge system. A revision to the FHA is required for the modification. The revised FHA will document any gaps with DOE-STD-1066 and ORP approval will be required for any associated equivalency(s) and/or exemption(s). It is expected there will be a gap as the planned modification does not include an automatic or manual deluge system or associated features like automatic fire detection, demisters, water drains, and lighting and window viewing ports. The release consequences from the facility fire are low and do not require SC or SS controls. Inclusion of the deluge system is expected to increase the project cost by over one million dollars, will significantly increase the life cycle cost of the facility and introduce the potential for flooding from inadvertent system activation or leaks, and worker exposure from routine operations to maintain the deluge system. The expected increased cost and worker risk would not be offset by any marginal increase in radiological control benefit from a deluge system. Additionally, the ventilation upgrade project is being accomplished with American Recovery & Reinvestment Act (ARRA) funding, so any significant delay in project start by a change in requirements to include a deluge system, might jeopardize the ARRA funding window, and preclude the planned upgrade to the ventilation system

Based on the discussions above, and the DSA analyses supporting a general service system, the Facility Evaluation Team recommends that no action be taken to modify the scope of the planned modification.

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Abbreviations and Acronyms

AC	Administrative Control
ALARA	As Low As Reasonably Achievable
ARRA	American Recovery & Reinvestment Act
CAM	Continuous Air Monitor
CW	Co-located Worker (100 meters)
DBA	Design Basis Accidents
DNFSB	Defense Nuclear Facilities Safety Board
DOE	Department of Energy
DSA	Documented Safety Analysis
DST	Double Shell Tank
EC	Evaluation Criteria
EG	Evaluation Guideline
HA	Hazard Analysis
HEPA	High Efficiency Particulate Air
MAR	Material at Risk
MCC	Motor Control Center
NPH	Natural Phenomena Hazard
PC	Performance Category
REM	Roentgen Equivalent Man
SC	Safety Class
SMP	Safety Management Program
SS	Safety Significant
SSC	Structures Systems and Components
TEDE	Total effective dose equivalent
TPC	Total Project Cost
TSR	Technical Safety Requirements
WRPS	Washington River Protection Solutions

1.0 INTRODUCTION

1.1 EVAPORATOR SYSTEMS OVERVIEW

Radioactive waste was received and stored in the tank farms in liquid form. The 242-A Evaporator is designed to reduce waste volume and the number of Double Shell Tanks (DSTs) required to store liquid waste generated at the Hanford Site. The process uses a conventional, forced-circulation, vacuum evaporation system operating at low pressure (approximately 60 Torr) and low temperature (approximately 50 °C [122 °F]) to concentrate radioactive waste solutions. The 242-A Evaporator has active ventilation systems. The ventilation systems work in concert with the facility floor plan (zones) to direct airflow from areas of lesser contamination potential to areas of greater contamination potential. Airlocks separate potentially contaminated areas from non-contaminated areas. Exhaust air passes through a cleanup system consisting of two stages of HEPA filters to ensure that releases meet DOE guidelines established in DOE O 5400.5 and are as low as reasonably achievable (ALARA).

1.2 EVAPORATOR VENTILATION SYSTEM

Operating the 242-A Evaporator generates several different waste streams including gaseous effluents. The K1 ventilation system services contaminated areas of the 242-A Building. Provisions are required to maintain confinement pressure differentials within the facility and to ensure that discharges of radioactive materials meet applicable regulations. The K1 exhaust stream is HEPA filtered, monitored for the presence of radioactive materials, and sampled to ensure that release limits are not exceeded.

The K1 ventilation system performs two safety functions: (1) maintains contaminated areas at a negative pressure relative to atmospheric and (2) filters and monitors exhaust air to ensure releases of radioactive and hazardous materials are within guidelines and ALARA.

The K1 ventilation system services the following contaminated or potentially contaminated areas:

- Evaporator room
- Pump room
- Load-out and hot-equipment storage room
- Condenser room
- Ion exchange room
- Loading room

The flow distribution to the rooms is shown in Figure 1 and Figure 2.

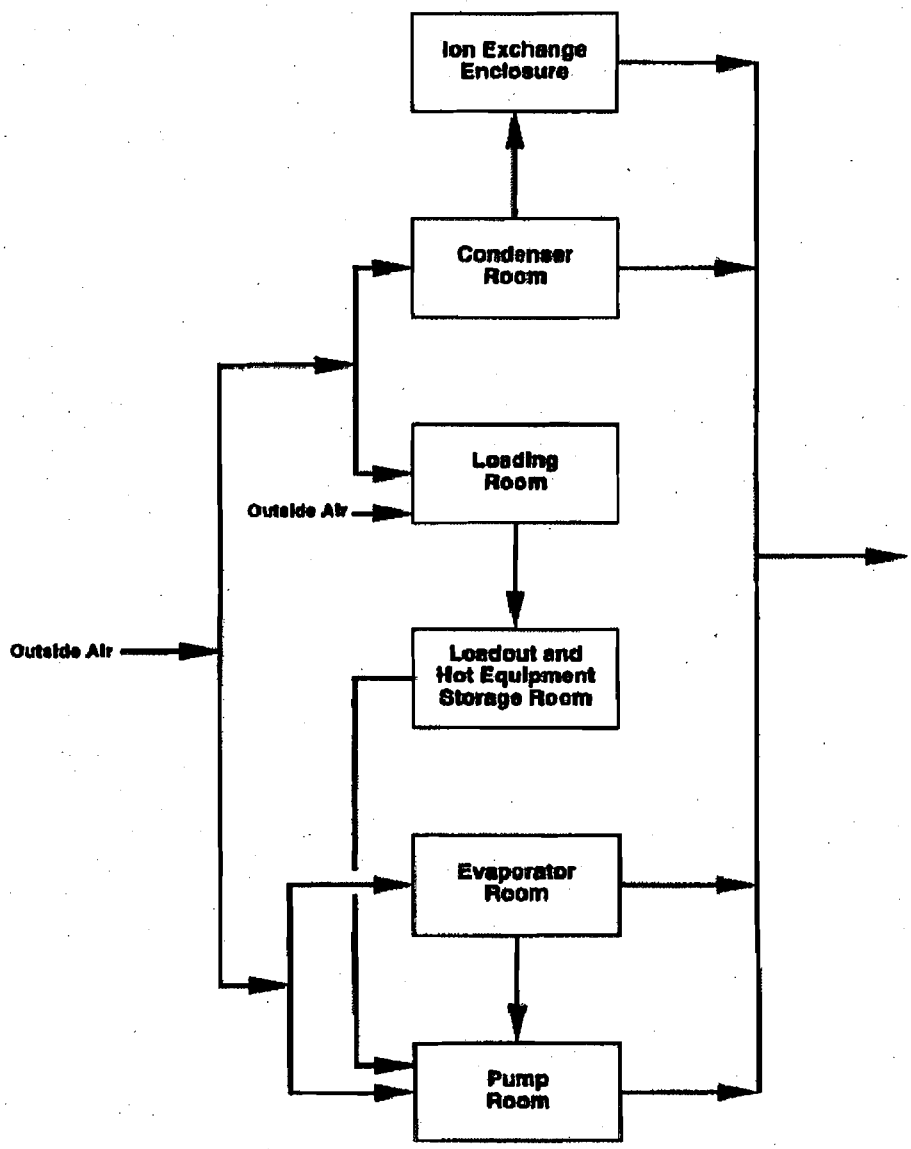

Figure 1 242-A Evaporator Building K1 Ventilation System Flow Distribution (Typical)

Note: Arrangement is representative of 242-A Evaporator Building.

systems documentation was reviewed to confirm system configuration. The system was then evaluated against the criteria in Table 5.1; as documented in Attachment 2.

Because the gap related to the underground ductwork to withstand a seismic event was discretionary and modifications to address these gaps would provide limited, if any, overall dose reduction, a cost/benefit analysis was not performed to replace the underground ducting.

As discussed in Table 5.1, a revision to the FHA is required for the modification. The revised FHA will document any gaps with DOE-STD-1066 and ORP approval will be required for any associated equivalency(s) and/or exemption(s). A rough order of magnitude cost estimate was performed for adding a deluge system to the planned modification. The design and installation was estimated at $1.1 M (WRPS estimate #2654). This does not include costs for cold weather protection and the significantly increased lifecycle cost for surveillance of the system. Additionally, a deluge system will introduce the potential for flooding from inadvertent system activation or leaks, and worker exposure from routine operations to maintain the deluge system.

Because these gaps are discretionary, the facility evaluation team does not recommend any change to the planned modification. The expected increased cost and worker risk would not be offset by any marginal decrease in radiological dose reduction. Additionally, the ventilation upgrade project is being accomplished with ARRA funding, so any significant delay in project start by a change in scope to address the discretionary gaps might jeopardize the ARRA funding window, and preclude the planned upgrade to the ventilation system

4.0 CONCLUSION

The 242-A Evaporator Facility has an active K1 ventilation system that is functionally classified as general service and meets the PC-1 criteria for applicable NPH events. This functional classification is based upon the low radiological and chemical consequences to both the 100-meter on-site and off-site receptors from the postulated events as evaluated in the 242-A Evaporator DSA (References 1). The unmitigated accident analyses assumed a Leak Path Factor of 1.0 and were performed assuming no active or passive confinement ventilation system.

The Facility Evaluation Team evaluated the K1 ventilation system and the proposed K1 exhauster upgrade (Reference 2) at the 242-A Evaporator Facility in accordance with the Reference 7, using the SS Table 5.1 criteria based on the Hazard Category 2 inventory levels in the evaporator. PC-2 criteria were used to assess functionality for applicable NPH events. The evaluation identified three gaps between the existing system design and the evaluation criteria and two gaps between expected ventilation system following the planned modification and the evaluation criteria. Based on the discussions above, and the DSA analyses supporting a general service system, the Facility Evaluation Team recommends that no action be taken to modify the scope of the planned modification

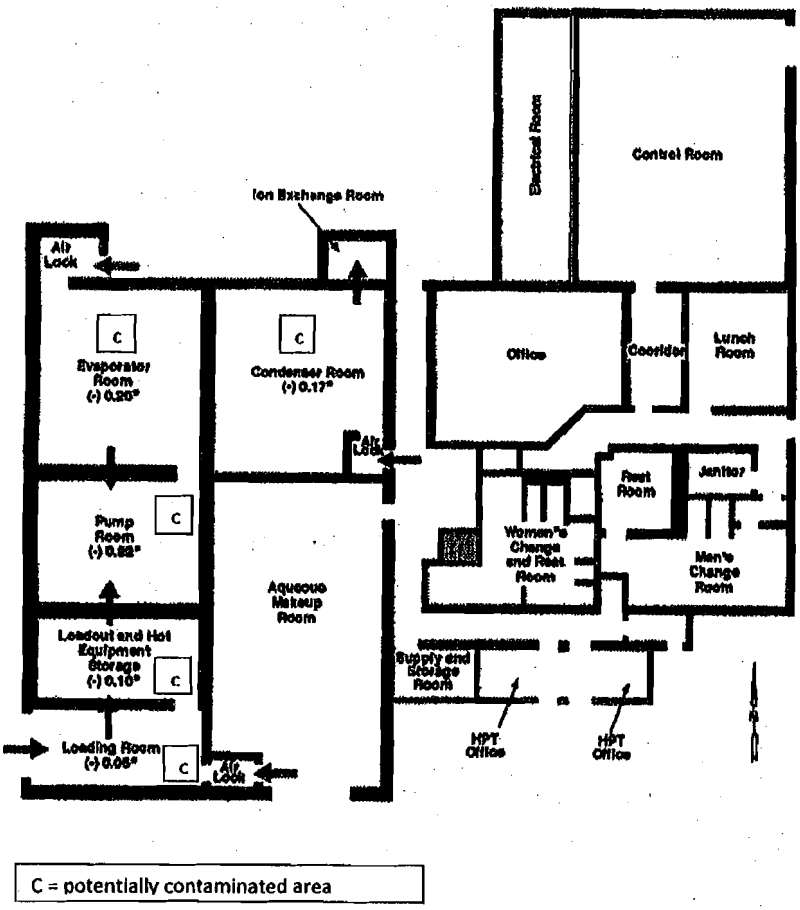

Figure 2 242-A Evaporator Building Negative Air Pressure Maintenance (Typical)

Note: Arrangement is representative of 242-A Evaporator Building. Arrows indicate direction of flow

The K1 ventilation system includes an air supply system and an air exhaust system. The primary components of the K1 ventilation system are listed below and shown in Figure 3:

- Preheat coil K1-2-1
- Roll filter (prefilter) K1-7-1
- Bag (final) filter K1-11-1
- Supply fan K1-5-1
- Electric heater HTR-K1-4-2
- Cooling coil K1-3-1
- Reheat coils K1-4-1 and K1-4-7
- Prefilters K1-15-1 and K1-15-2
- HEPA filters K1-6-1 through 4
- Automatic dampers K1-FD-1-1 and K1-FD-1-2
- Exhaust fan K1-5-2
- Exhaust fan K1-5-3
- Evaporator room recirculation fan K1-9-1 (not shown).

The K1 ventilation system is a once-through air system. The K1 supply fan (K1-5-1) supplies outside air throughout the ventilated areas as shown in Figure 1. The ion exchange room is empty; the condenser room contains the condensers and condensate collection tank; the loading room contains no installed equipment; the load-out and hot equipment storage room contains sampling equipment for sampling the evaporator feed and process slurry; the evaporator room contains the evaporator vessel; and the pump room contains the recirculation pump, slurry pump, and process jumpers. Negative air pressure is maintained in K1 serviced areas as shown in Figure 2. Air is drawn through two parallel two-stage HEPA filter enclosures and discharged through an elevated stack by one of two K1 exhaust fans (K1-5-3 or K1-5-2). The discharge stack is equipped with stack sampling system record sampler and Continuous Air Monitor (CAM).

The exhaust portion of the K1 ventilation system consists of exhaust ducts that draw the air out of the various areas served by the K1 system. The exhaust ducts join at a common header that serves as the inlet to two HEPA Filter Units. The HEPA Filter Units are identical, each consisting of manual inlet and outlet dampers, a pre-filter, and two stages of HEPA filters. During normal operation, both filter units are in service. Each HEPA filter in the units is provided with a differential pressure instrument to monitor the condition of the filter. At the outlet of the filter units, the ductwork again joins to form a common header. This common header serves as the suction header for the K1 Exhaust Fans. Both fans feed exhaust air to a single stack that is equipped with air sample stack monitoring equipment. The exhaust fans are powered from a motor control center (MCC) that can receive backup power from a diesel generator. The K1 exhauster is shown in Figure 4.

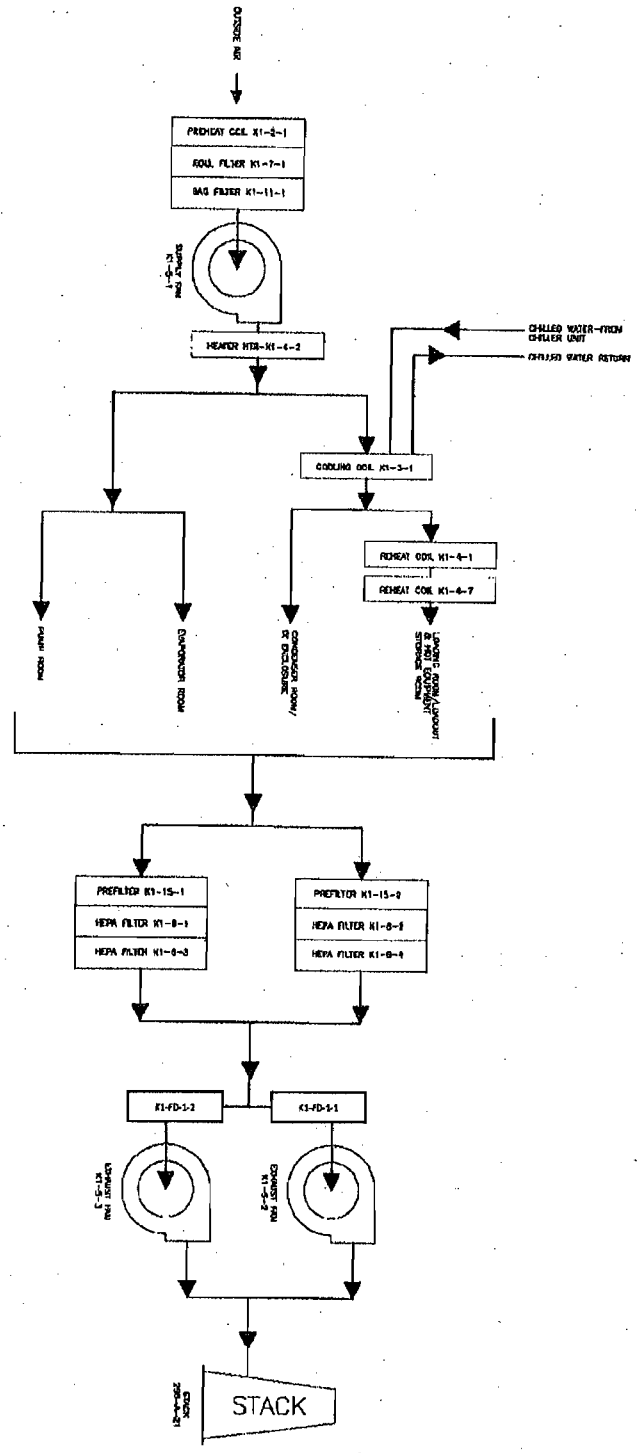

Figure 3 242-A Evaporator K1 Ventilation System Components

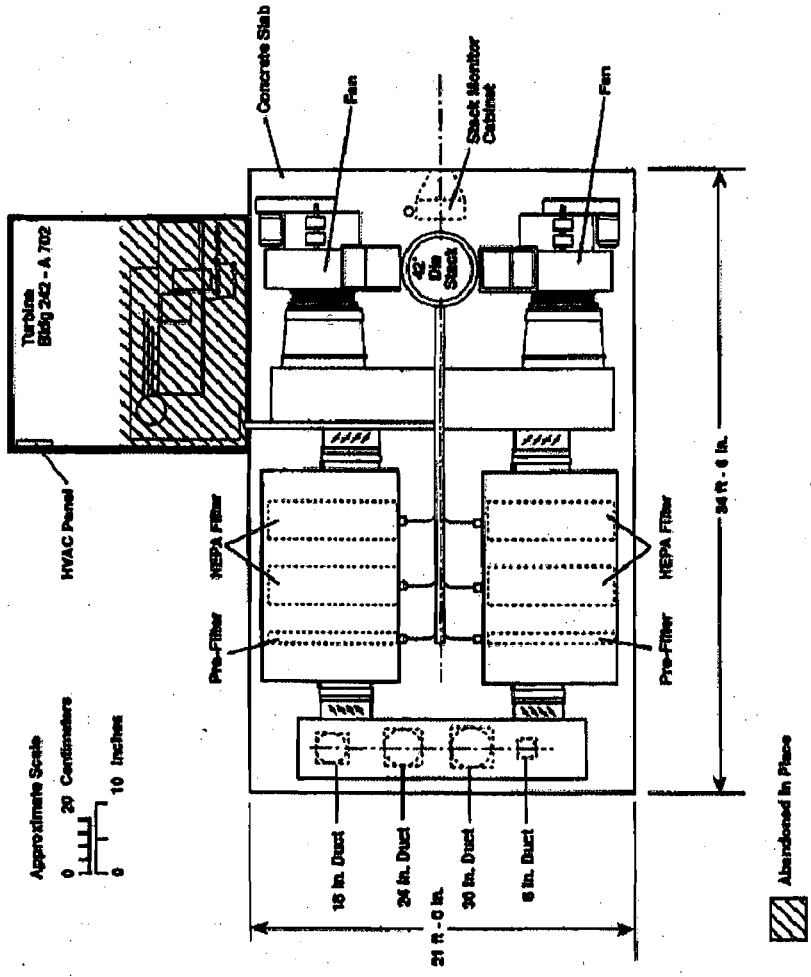

Figure 4 242-A Evaporator Exhauster

The K1 ventilation system is equipped with several status signals:

- High CAM activity
- CAM low flow
- CAM failure
- Record sample low flow
- high and low differential pressure across the HEPA filters
- low exhaust flow rate

The K1 ventilation system contains sufficient instrumentation to monitor and control air flows and the required negative pressures of specified compartments. Monitoring instrumentation includes exhaust air radioactivity detection and alarm. Instrumentation also provides monitoring and alarm of differential pressure across HEPA filters for plant control and maintenance. In addition, instrumentation provides controls and interlocks of critical components to initiate operation of the standby unit in the event of failure of the operating component.

1.3 MODIFICATIONS

The 242-A Evaporator has been in operation for over 30 years. The facility is expected to continue with service for many more years. Evaporator upgrades have been identified which will extend the life of the facility to support the mission. One such upgrade involves the K1 exhaust system. The K1 exhaust system has provided building ventilation and contamination control since the 1970s. Several components of this exhaust system will be replaced as part of an ongoing facility life extension program. The K1 exhaust upgrade will be conducted as part of the overall Tank Farm ARRA project. Upgrades to the supply side of the K1 system were conducted and completed during Phase I of Project E-528, in fiscal years 2007 and 2008.

The K1 exhaust system upgrade replaces all exhaust equipment downstream of the underground ventilation duct as shown in Figure 5. The underground duct, not part of the scope of the modification, shown in Figure 5 is comprised of 4 sections that connect to a single inlet manifold header. This header is located north of the evaporator room. The upgrade will be conducted in three stages. Stage I involves the design and procurement of all major components excluding the inlet manifold header. These components will be assembled and factory acceptance tests will be conducted in accordance with Reference 2. Stage II is for work scope conducted at the 242-A Evaporator to install all components of the K1 exhaust upgrade including connections to facility electrical services and facility control systems and monitoring systems. Stage II work scope will include the inlet manifold duct design, fabrication and field installation activity. Stage II will be performed in accordance with Reference 3. Stage III involves operational acceptance testing (OAT). The OAT for the K1 exhaust upgrade will be prepared and performed by Washington River Protection Solutions (WRPS).

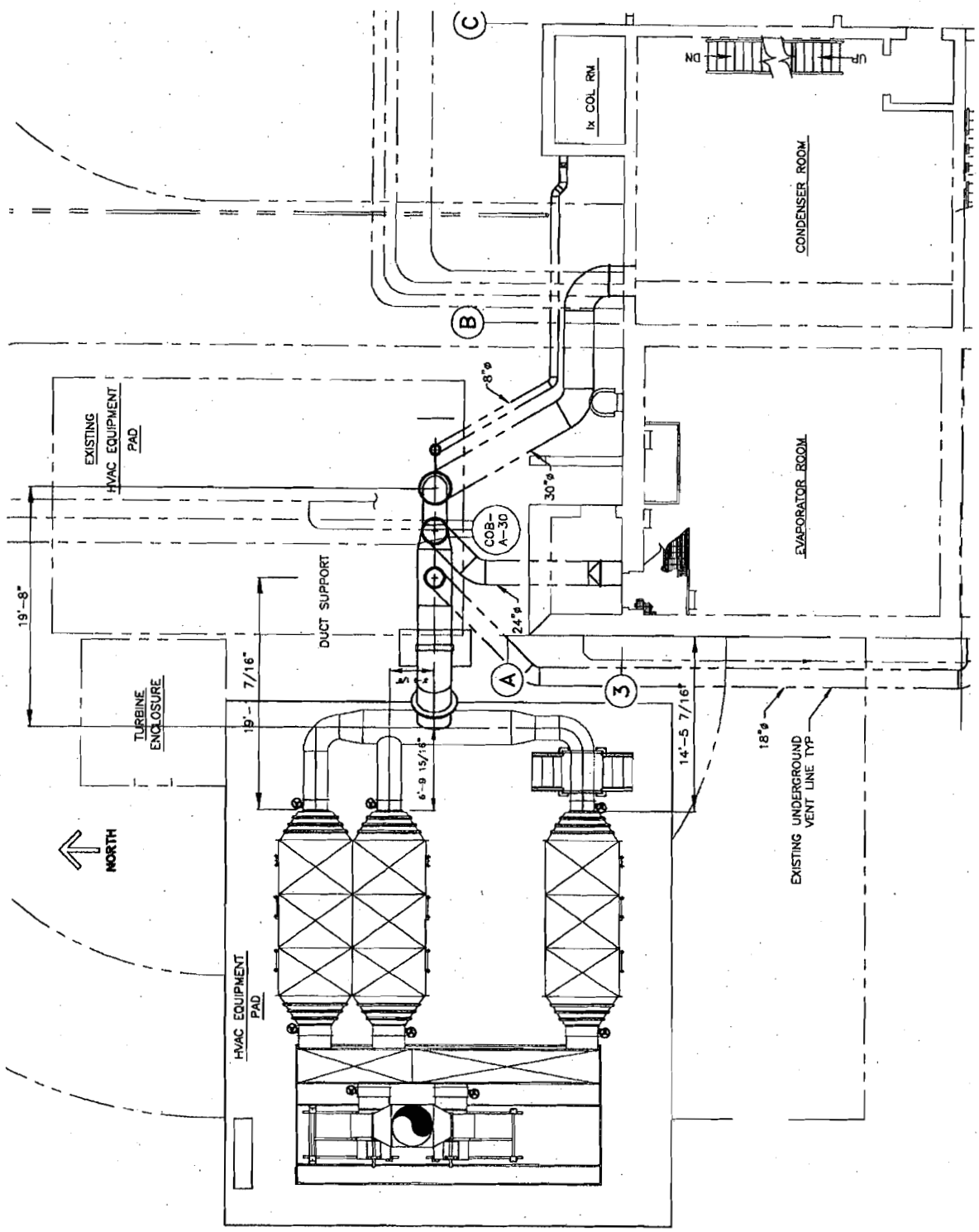

Figure 5 242-A Evaporator K1 Exhauster (Upgrade)

Components of the K1 exhaust upgrade include:

- Support bases
- Ductwork
- Isolation valves
- Dampers
- Filter train assembly
- Common switching plenum
- Exhaust fan and motor
- Stack
- Power Distribution System
- Instrumentation
- Stack Sampling and Monitoring System
- Permanent Stack Platform

In addition, the upgrade includes the following required and anticipated modifications to the original system configuration:

- A fire screen will be added to the inlet duct
- A third HEPA filter housing will be added
- HEPA filter instrumentation design will be changed from the use of separate pressure switches (for control room alarms) and pressure indicators (for local indication) to a single combined pressure differential indicator transmitter which indicates locally and sends a signal to the remote monitoring and control system.

The upgrade will not alter the function and operating parameters of the K1 system. The nominal system flow rate will remain at or near the rate described in Reference 4.

2.0 FUNCTIONAL CLASSIFICATION ASSESSMENT

2.1 EXISTING CLASSIFICATION

The active K1 confinement ventilation system in the 242-A Evaporator is functionally classified as general service.

2.2 EVALUATION

There are no safety significant (SS) or safety class (SC) functions for the existing K1 ventilation system associated with the 242-A Evaporator. The K1 ventilation system is not credited by the 242-A Evaporator DSA to operate during or following any design basis accident (DBA) events, including natural phenomena hazard (NPH) events.

The methodology used in the DSA for hazard analysis is based on the safety analysis and risk assessment handbook (SARAH) Reference 6. The purpose of the hazards analysis was to identify and assess the significance of a comprehensive set of potential hazardous conditions for the 242-A Evaporator. From this set of hazardous conditions, representative and bounding sets of accidents were selected for further analysis; the result is a comprehensive set of controls. In accordance with the SARAH, the hazards analysis was performed as an unmitigated hazards analysis. Hazards that can contribute to the uncontrolled release of radioactive or hazardous materials (called hazardous conditions) were systematically and comprehensively identified through the hazards analysis process. Results of this accident analysis were used to identify safety-related structure system and components (SSCs) for the appropriate accidents and hazardous conditions identified.

The risk of hazardous conditions on three potential receptors was estimated: (1) the maximally exposed offsite individual (MOI), a value integrated around all directions at the actual site boundary distance; (2) a person located 100 m from the facility (co-located worker, or CW); and (3) the facility worker (FW).

The DSA did not identify any evaporator events that challenge the Evaluation Guideline of 25 rem total effective dose equivalent (TEDE) for the MOI (where 1 rem is considered to be challenging the evaluation guideline) or the radiological consequences to the collocated worker when calculated and compared to the 25 rem TEDE evaluation guideline for "moderate" consequences and the 100 rem TEDE evaluation guideline for "high" consequences (SARAH).

The bounding accident events described in the DSA include:

- SPILL from the C-A-1 evaporator vessel releasing its contents. This bounding accident results in an unmitigated dose consequence of 3.7 rem to the CW and 3.3 mrem for the MOI. The risks to the CW and MOI are sufficiently low to not warrant additional credited controls to lower risk. The risk to the FW is considered high and requires significant reduction by the consideration of safety-significant SSCs and/or TSRs. FW safety is achieved through implementation of the identified SSC's TRS-ACs, and defense in depth controls described in the DSA. (Note: In practice, personnel are restricted from entering the evaporator room when the 242-A Evaporator is operating.) The K1 ventilation is not credited in this accident as a control risk reduction feature for the FW. Therefore the K1 ventilation system is appropriately classified as general service for the bounding spill accident.

- Fire in the evaporator room. This bounding accident results in an unmitigated cumulative dose consequence of 9.8 rem to the CW and 30 mrem for the MOI. Consequences to the FW were qualitatively determined not to be significant. Therefore, there is no need for safety-significant SSCs, or for TSR level AC controls. Worker safety is primarily achieved through implementation of emergency response requirements. Declaring the 242-A evaporator room and pump room walls, floors, and cover blocks a safety significant design feature also provides protection for FW personnel. Furthermore, workers are restricted from being in the proximity of vessel C-A-1 when the evaporator is charged. The K1 ventilation is not credited in this accident as a control risk reduction feature. Therefore the K1 ventilation system is appropriately classified as general service for the bounding fire accident.

- DEFLAGRATION or DETONATION in the evaporator headspace. This bounding accident results in an unmitigated cumulative dose consequence of 21 rem to the CW and 63 mrem for the MOI. The risk to the MOI is considered not significant. The risk for the CW and FW are considered moderate and requires reduction by the consideration of SSCs, TSR-ACs, and defense in depth controls. Further facility worker safety is provided by TSR-AC requirement that restricts workers from being in the proximity of vessel C-A-1 when the evaporator is charged. FW and CW safety is achieved through implementation of the identified SSC's, TRS-ACs, and defense in depth controls described in the DSA. The K1 ventilation is not credited in this accident as a control risk reduction feature for the FW or CW. Therefore the K1 ventilation system is appropriately classified as general service for the bounding deflagration or detonation accident.

2.3 SUMMARY

The general service functional classification of the K1 confinement ventilation systems for 242–A Evaporator is appropriate.

3.0 SYSTEM EVALUATION

WRPS evaluated the K1 confinement ventilation systems at the 242-A Evaporator Facility in accordance with Reference 7. Tables 4.3 (Attachment 1) was developed from the 242-A Evaporator DSA events. Systems were evaluated and documentation was reviewed to confirm system configuration by the associated System Engineer for the evaporator. System configurations were evaluated against the criteria in Table 5.1, as requested by ORP, and documented in Attachment 2.

3.1 IDENTIFICATION OF GAPS

This assessment evaluated the ventilation systems and supporting SSCs in the 242-A Evaporator Facility against SS/PC-2 criteria. The methodology and events chosen were previously documented in Table 4.3.

The SS classification and the associated attributes in Table 5.1 were used as a guide so that the active confinement ventilation systems could be evaluated to a common set of criteria. This evaluation involved the existing K1 system and the proposed K1 exhauster upgrade.

When developing Table 5.1, the following 242-A Evaporator DSA events were considered:

- Evaporator bounding spill event
- Evaporator fire in the evaporator room
- Evaporator deflagration or detonation in the evaporator vessel
- Credible NPH events (wind, seismic, snow loading, volcano/ashfall loading)

The following is a summary of the Table 5.1 evaluation criteria (EC) discretionary gaps for the 242-A Evaporator ventilation system and existing K1 exhauster:

Criteria: Confinement ventilation systems should withstand credible fire events and be available to operate and maintain confinement

Gap: The K1 ventilation system does not include ember screens or a manual or automatic deluge system, nor is it separated from the facility by a fire wall as required by DOE-STD-1066. The gap to DOE-STD-1066 requirements for a deluge system includes automatic fire detection, demisters, water drains and lighting and window viewing ports. However, the ventilation system is not credited in the DSA to operate or maintain confinement integrity during or following any DBA events.

Criteria: Confinement ventilation systems should safely withstand earthquakes

Gap: The underground ductwork and the above grade portions of the exhaust system may not withstand seismic loading, however the evaporator ventilation systems are not credited in the DSA to perform any safety function during or following a seismic event

Criteria: Design supports the periodic inspection & testing of filters and housing, and test & inspections are conducted periodically.

Gap: The current design does not include test connections that allow the HEPA filter banks to be tested individually.

The 242-A Evaporator K1 exhauster upgrade includes provisions for ember screens, individual test ports for HEPA banks, and PC-2 loading. This eliminates one of the gaps and reduces the scope of the other two. The following is a summary of the Table 5.1 evaluation criteria (EC) discretionary gaps following the K1 exhauster upgrade:

Criteria: Confinement ventilation systems should withstand credible fire events and be available to operate and maintain confinement

Gap: A revision to the FHA is required for the modification. The revised FHA will document any gaps with DOE-STD-1066 and ORP approval will be required for any associated equivalency(s) and/or exemption(s). It is expected there will be a gap as the planned modification does not include an automatic or manual deluge system or associated features like automatic fire detection, demisters, water drains, and lighting and window viewing ports. However, the ventilation system is not credited in the DSA to operate or maintain confinement integrity during or following any DBA events.

Criteria: Confinement ventilation systems should safely withstand earthquakes

Gap: Following the modification, the only portion of the ventilation system that may be vulnerable to seismic event is the underground duct work as it is not within the scope of the modification. However the evaporator ventilation systems are not credited in the DSA to perform any safety function during or following a seismic event.

3.2 GAP EVALUATIONS

The 242-A Evaporator K1 ventilation system was compared with SS system performance criteria listed in Table 5.1 of Reference 7. In order to perform this evaluation, ventilation and support

5.0 REFERENCES

1. HNF-14755, Documented Safety Analysis for the 242-A Evaporator, Rev. 2-B, Washington River Protection Solutions, May 2009.
2. RPP-SPEC-36062, Procurement Specification for the 242-A Evaporator K1 Exhaust Ventilation System, Rev. 0, Washington River Protection Solutions, Richland, Washington, July 2009.
3. Requisition # 197877, Statement of Work, BMA #30519: 242-A K1 Ventilation Upgrade Installation Design, Washington River Protection Solutions, Richland, Washington, November 2009.
4. H-2-830594, Sht. 2, 242-A Evaporator HVAC P & ID, Rev. 4, US Department of Energy, Office of River Protection, April 2009.
5. Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses, Change Notice No. 3, DOE-STD-3009-94, U.S. Department of Energy, Washington, DC, March 2006
6. HNF-8739, Hanford Safety Analysis and Risk Assessment Handbook (SARAH), Rev. 1, Fluor Hanford, Richland, Washington, December 2004
7. Deliverables 8.5.4 and 8.7 of Implementation Plan for DNFSB Recommendation 2004-2, Ventilation System Evaluation Guidance for Safety-Related and Non-Safety-Related Systems, U.S. Department of Energy, Washington, DC, January 2006.
8. Radiation Protection of the Public and the Environment, DOE Order 5400.5, U.S. Department of Energy, Washington, DC, February 1990.

Attachment 1

2004-2 Common Table 4.3 for 242-A Evaporator Ventilation System

Table 4.3 Confinement Documented Safety Analysis Information										
242-A Evaporator K1 Ventilation System				Hazard Category 2				Performance Expectations		
Bounding Accidents	Containment Type		Doses Unmitigated/ Mitigated MOI = Offsite CW = Onsite	Containment Class			Safety Function	Functional Requirements	Performance Requirements	Compensatory Measures
	Active	Passive		SC	SS	DID				
3.4.2.1 Bounding Spill Event. [1]	None credited	None credited (LPF=1.0)	Unmitigated **MOI < 0.1 rem** **CW = 3.7 rem** Mitigated **MOI < 0.1 rem** **CW = 3.7 rem**	None Required	None Required	None Required	No credit is taken for confinement by the K1 ventilation system in this scenario.	NA	NA	NA
3.4.2.2 Fire in Evaporator Room. [2]	None credited	None credited (LPF=1.0)	Unmitigated **MOI < 0.1 rem** **CW = 9.8 rem**[3] Mitigated **MOI < 0.1 rem** **CW = 9.8 rem**[3]	None Required	None Required	None Required	No credit is taken for confinement by the K1 ventilation system in this scenario.	NA	NA	NA
3.4.2.3 Deflagration or Detonation in Evaporator Vessel.[4]	None credited	None credited (LPF=1.0)	Unmitigated **MOI < 0.1 rem** **CW = 21 rem** Mitigated **MOI < 0.1 rem** **CW = 21 rem**	None Required	None Required	None Required	No credit is taken for confinement by the K1 ventilation system in this scenario.	NA	NA	NA

[1] Seismic event collapses 242-A Building structure damaging an evaporator room roof cover block and causing it to fall on the C-A-1 vessel releasing the C-A-1 vessel contents. This scenario bounds all spill/leak incidents caused by mechanical, external, and natural phenomena based initiators that can cause loss of containment of the slurry in the C-A-1 vessel.

[2] Ignition of transient combustibles in evaporator room cause gaskets to fail, slurry to leak, and the contaminated air or stream to be dispersed. This scenario bounds all non-deflagration or detonation fire incidents caused by mechanical, external, and natural phenomena based initiators.

[3] Previously reported consequences of 3.2 rem. were recalculated in the safety basis amendment to update the 242-A Evaporator room fire accident {Ref: CH2M-0801446 and 08-NSD-33}

[4] Flammable gas accumulates in the evaporator vessel due to a loss of vacuum with ignition from an unidentified initiator. The evaporator vessel is damaged, slurry is released into the air, and the contaminated air is dispersed. This scenario bounds all deflagration, detonation, and explosion events caused by mechanical, external, and natural phenomena based initiators

Attachment 2

2004-2 Table 5.1, 242-A K1 Ventilation System Performance Criteria

2004-2 Table 5.1, 242-A K1 Ventilation System Performance Criteria		
Evaluation Criteria	**Discussion**	**Reference**
	1 - Ventilation System – General Criteria	
Pressure differential should be maintained between zones and atmosphere.	The K1 ventilation system is designed to maintain the evaporator room and pump room at a lower pressure relative to the environment for normal operating conditions. These rooms are monitored by PDIT-K1-304, -304A and -305 to ensure differential pressure are maintained within the limits. The K1 ventilation system meets section 2.2.9 of DOE-HDBK-1169 References H-2-830594, Sht. 2 Gap Analysis No gap Change following Modification None References RPP-SPEC-36062, Section 3.1.2 and Appendix E "P&ID Design Sketches" Gap Analysis No gap.	**DOE-HDBK-1169 (2.2.9) ASHRAE Design Guide, Section 2**
Materials of construction should be appropriate for normal, abnormal and accident conditions.	Materials of construction for the exterior portion of the K1 Ventilation exhaust duct is 16-gauge galvanized steel up to the fan. The HEPA filter housings are standard stainless steel Flanders construction. Exhaust fans are constructed of galvanized carbon steel. A portion of the K1 ventilation exhaust duct is underground. These ducts are 8, 18, 24, and 30 in. in diameter and meet at a common header at the equipment pad. The ducts are schedule 10-gage black steel pipe. The design and materials of exterior construction are compatible with the outdoor conditions typically experienced in the northwestern United States. The materials of construction are compatible with the conditions expected following abnormal conditions or accidents involving spill of process fluids. There are no other toxic materials or acids in the airstream that will damage the ventilation equipment. The current K1 system has operated with no signs of material degradation. References H-2-69295, H-2-69297, H-2-69299 Sht. 1, HNF-14755 Section 2.6.1.1 Gap Analysis No gap Change following Modification The ducting for the above grade portion of the ventilation exhaust system from the plenum up to the stack will be stainless steel. References RPP-SPEC-36062, Section 3.2.1 and Section 3.3.2 Gap Analysis No gap.	**DOE Nuclear Air Cleaning Handbook 1169 Section 2.2.5 – Corrosion ASME AG-1**
Exhaust system should withstand anticipated normal, abnormal and accident system conditions and maintain confinement integrity.	The K1 ventilation system was designed for normal and abnormal operations. Although it is not credited in the DSA to operate or maintain confinement integrity during or following any DBA event, including NPH events, conditions expected following the various spill events will not impact the K1 ventilation exhaust system as the materials of construction are compatible with the process fluid. In the event of a loss of normal power the ventilation system exhaust and supply fan shutdown (K1-5-3 and K1-5-1 respectively) and the VCS continues to operate and enables the backup exhaust fan (K1-5-2) to operate on backup power with continued flow through the HEPA filters. Since the supply fan (K1-5-1) is not on backup power, the pressure in the pump and evaporator rooms is maintained negative. If backup power is disabled, control dampers fail in a safe position to ensure the pressure in the pump and evaporator rooms is maintained negative. Additionally, the K1 ventilation system is not impacted by deflagration in the evaporator vessel as that is exhausted by the vessel vent system. Impacts to the system from Fire and NPH events are discussed later. Reference	**DOE-HDBK-1169 (2.4) ASHRAE Design Guide**

2004-2 Table 5.1, 242-A K1 Ventilation System Performance Criteria		
Evaluation Criteria	**Discussion**	**Reference**
	HNF-14755, Section 2.4.2.1.5.1 Gap Analysis No gap. Change following Modification None References RPP-SPEC-36062, Section 3.2.5 Gap Analysis No gap.	
Confinement ventilation systems shall have appropriate filtration to minimize release.	HEPA filter house specification consists of 11 and 14 gauge 304 stainless steel. Housing is total welded construction. (Code Welding). Housing conforms to leak tightness per criteria of DOE Nuclear Air Cleaning Handbook and ASME N510. The flow capacity of the HEPA filters is 1000 cfm at pressure differential of 1" wg. The K1 ventilation system is not credited to operate or maintain confinement integrity during or following any DBA event, thus the accident analysis makes no assumptions regarding decontamination factors for the HEPA filters. Exhaust HEPA Cabinet and Filter Flanders Model (E-5) 1 X 1 GG-F2 (304) L Type 1 (Cabinet). Flanders Model GG-F (24" x 24" x 11-1/2") (Filter) 99.97% efficient, 304L SST frame, separator less, with extractor clips, 3/4" deep channel filled with fluid sealant upstream, SST faceguards both sides. HEPA Filter Specifications Flanders Nuclear Grade HEPA Filter, HNF-S-0552 HEPA Filter Performance Testing In-place leak testing of HEPA filter installation is performed in accordance with Maintenance Procedure 3-VBP-656, "242-A Evaporator HEPA Filter In-Place Leak Test (Aerosol Test)". In-place leak testing is performed annually to detect deterioration of filters, gaskets or other causes that could result in leaks. Testing is also done in a manner that will detect airflow that may bypass HEPA filters. The HEPA filters are replaced when needed based on results of testing. Reference HNF-S-0552, RPP-16922 Section 14.7.3, 3-VBP-656, RPP-11413, RPP-CALC-34584 Gap Analysis No gap. Change following Modification The above grade portion of the ventilation exhaust system will be fabricated and assembled to meet the requirements of ASME N509-2002, ASME N510-1989, and ASME AG-1. The SPEC calls out a filter housing that will accept Nuclear Grade HEPA filters sized 24" x 24" x 11-1/2", fluid seals. The HEPA filter housing will be a 3 x 3 filter array, style Bag-In/Bag-Out, with filter extractors. HEPA filter housing will be constructed of stainless steel. Engineering calculation will determine required gage thickness. The new filter housing is total (100%) welded construction. The filter housing will be designed to be pressure decay leak tested to meet the requirements of ASME N510, Section 6 to not exceed 0.1% of the housing volume per hour at the system leak test pressure as defined in ASME AG-1 for leakage Class I (Table SA-B-1310). HEPA filter element holding frames at each filter position will be designed to be pressure decay leak tested in accordance with the requirement of ASME N510, Section 7 to not exceed 0.1% of the housing volume per hour at the system leak test pressure as defined in ASME AG-1 for leakage Class I (Table SA-B-1310). The flow capacity of the Nuclear Grade HEPA filters is 1250 – 1500 cfm at 1.3" wg initial pressure differential. References RPP-SPEC-36062, Section 3.1 and Section 3.3.2	**DOE Nuclear Air Cleaning Handbook 1169 Section 2.2.1 Airborne Particulate and Gases ASME AG-1 Table FC-5140 ASME N509-2002 ASME N510**

2004-2 Table 5.1, 242-A K1 Ventilation System Performance Criteria		
Evaluation Criteria	**Discussion**	**Reference**
	Gap Analysis No gap.	
	2 - Ventilation System – Instrumentation & Control	
Provide system status instrumentation and/or alarms.	The K1 ventilation system is instrumented with alarms in the control room for high HEPA filter dP and loss of fan power (motor not running). The K1 ventilation system pressures are monitored locally via routine operator rounds and also alarmed and displayed on the ventilation control system (VCS). Reference H-2-830594, Sht.5, TO-620-020, TF-OR-PWR-03, ARP-T-601-VCS, A-2 Gap Analysis No gap. Change following Modification The new system will additionally allow for information only monitoring of ventilation pre-filter and HEPA filter differential pressure readings on the Evaporator Monitoring and Control System (MCS). References RPP-SPEC-36062, Section 3.3.4 and Appendix E "P&ID Design Sketches" Gap Analysis No gap.	**DOE Nuclear Air Cleaning Handbook 1169** **AHSRAE Design Guide (Section 4)** **ASME AG-1**
Interlock supply and exhaust fans to prevent positive pressure differential.	The K1ventilation system are equipped with a supply fan that is interlocked (hardwire and software) to shutdown on loss of power to the exhaust fans (K-5-3) or increased pressure in the evaporator or pump rooms. Low pressure alarms for 1st and 2nd stage HEPA filters will notify operators of filter breakthrough.. Reference H-2-830594, Sht. 5, HNF-14755 Section 2.5.9.8.5. Gap Analysis No gap. Change following Modification None References RPP-SPEC-36062, Section 3.1.4 and Section 3.3.4 Gap Analysis No gap.	**DOE-HDBK-1169 ASHRAE Design Guide (Section 4)**

2004-2 Table 5.1, 242-A K1 Ventilation System Performance Criteria		
Evaluation Criteria	**Discussion**	**Reference**
Post accident indication of filter break-through.	The K1 ventilation system has an installed Continuous Air Monitor (CAM) to detect increased levels of radiation in the exhaust stack. CAM indications and alarms are monitored on the MCS. Pressure differential across the HEPA filters is indicated at gages located locally and is monitored on the MCS. Although it is not credited in the DSA to operate or maintain confinement integrity during or following any DBA event, including NPH events, local monitoring of HEPA filter pressure differential is expected to be available. The K1 Ventilation System has indication of filter break through (post accident) and meets the intent of DNFSB Tech 34. References FF-01 Record Sampler, H-2-830594, Sht. 2 Gap Analysis No gap Change following Modification None References RPP-SPEC-36062, Section 3.3.4 Gap Analysis No gap	**DNFSB Tech 34**
Reliability of control system to maintain confinement function under normal, abnormal and accident conditions.	In addition to local monitoring, the K1 ventilation system has automatic control features and interlocks. Although the evaporator cell ventilation system is not credited for operating during or after a DSA accident, the control system is expected to be available. The control system is powered by the backup power supply source in the event of loss of normal power. Additionally, the ventilation system has the capability to be operated manually and during loss of air supply the damper actuator control arm can be manually moved and locked in place with adjusting screw. Reference H-2-830594 Sht. 5, HNF-14755 Section 2.5.9.8.5 and Section 4.4.1. Gap Analysis No gap Change following Modification None References RPP-SPEC-36062 Section 3.3.4 and Appendix E "P&ID Design Sketches" Gap Analysis No gap.	**DOE Nuclear Air Cleaning Handbook 1169 Section 2.4 ASME AG-1**

2004-2 Table 5.1, 242-A K1 Ventilation System Performance Criteria		
Evaluation Criteria	**Discussion**	**Reference**
Control components should fail safe.	Exhaust fan K1-5-3 is the primary operating exhaust fan. In the event of a total loss of power, the ventilation system exhaust (K1-5-3) and supply (K1-5-2) fans will shutdown. The damper upstream of the backup exhaust fan (K1-5-2) is air operated fail open and the damper upstream of the other exhaust fan (K1-5-3) is air operated fail closed. Thus, the pressure in the pump and evaporator rooms is maintained negative. UPS provides power for instruments to ensure safe shutdown of the facility. Reference H-2-830594 Sht. 2 and Sht. 5, HNF-14755 Section 2.5.9.8.3 and Section 2.5.9.8.5 Gap Analysis No gap. Change following Modification The pneumatic dampers K1-FD-1-1 and K1-FD-1-2 will be replaced with electric actuated dampers. References RPP-SPEC-36062 Section 3.1.3.6, and Appendix B Gap Analysis No gap.	**DOE-HDBK-1169 (2.4)**
3 - Resistance to Internal Events – Fire		
Confinement ventilation systems should withstand credible fire events and be available to operate and maintain confinement.	The HEPA filter housings are constructed of stainless steel. The K-1 prefilters are designed to the requirements of UL 900 (Class1). These materials are resistant to the effects of fire events. The HEPA filters are designed to UL 586. The Fire Hazards Analysis (FHA) documents that the design of the filters will withstand the expected gas temperatures generated during Evaporator Room fire and ignition of the filters during an Evaporator Room fire is not expected. A fire in the Evaporator or pump room is expected to load the K1 exhaust HEPA filters to approximately half of the loading necessary to expose the HEPA filters to their burst pressure of 10 in. WG. [Ref: HNF-SD-WM-FHA-024, Section 6.1 and 6.4.10]. The FHA could not rule out the possibility that a burning brand (ember) could reach the filters, resulting in a burn through. The ventilation fans are located outdoors. These locations lack any significant combustible materials. The DSA (Table 3.3-11) documents the fire scenario (range fire) involving the 242-A Evaporator facility. The Fire Protection Program is allocated as a control to ensure that combustible materials are controlled to minimize the potential for fire in such locations. Although not credited in the FHA, the portions of the facility that contain combustibles are covered by a sprinkler system. The K-1 ventilation system does not include ember screens or an automatic or manual deluge system, nor is the filter plenum housing separated from the adjacent building by a fire wall. Reference HNF-14755 Section 3.4.2.2, HNF-WM-SD-FHA-024 Gap Analysis There is a gap as the K1 ventilation system does not include ember screens or an automatic or manual deluge system, nor is it separated from the facility by a fire wall as required by DOE-STD-1066. The gap to DOE-STD-1066 requirements for a deluge system includes automatic fire detection, demisters, water drains and lighting and window viewing ports. However, the ventilation system is not credited in the DSA to operate or maintain confinement integrity during or following any DBA events. Change following Modification An ember screen in the inlet damper assembly is specified to address the vulnerability related to filter burn through caused by embers. The fire screen will be located at least 20 feet upstream of the pre-filter. The pre-filter will be at least 36" upstream of the final HEPA filter. The filter enclosure will be approximately 15 feet from the nearest facility wall. References RPP-SPEC-36062, Section 3.1.2, Section 3.3.2.2. Note the fire screen is referenced in the K1 procurement specification. The design and installation activity associated with the fire screen will be performed to SOW, Requisition # 197877, "BMA #30519: 242-A K1 Ventilation Upgrade Installation Design".	**DOE-HDBK-1169 (10.1)** **DOE-STD-1066**

2004-2 Table 5.1, 242-A K1 Ventilation System Performance Criteria		
Evaluation Criteria	**Discussion**	**Reference**
	Gap Analysis A revision to the FHA is required for the modification. The revised FHA will document any gaps with DOE-STD-1066 and ORP approval will be required for any associated equivalency(s) and/or exemption(s). It is expected there will be a gap as the planned modification does not include an automatic or manual deluge system or associated features like automatic fire detection, demisters, water drains, and lighting and window viewing ports. However, the ventilation system is not credited in the DSA to operate or maintain confinement integrity during or following any DBA events.	
Confinement ventilation systems should not propagate spread of fire.	The 242-A evaporator and pump room ventilation system are vented in parallel. A fire in the evaporator or pump room (Medium Fire FHA Section 6.1) would be vented directly to the outside via the K1 HEPA filter banks and exhaust fans. The Fire Protection Program (e.g., fire detection and suppression systems) and TSR limits on combustible loading limits the probability of a damaging fire. The DSA (Table 3.3-11) documents that the FIR-2 is the credible fire scenario involving the evaporator and pump rooms. The ventilation system materials of construction are resistant to the effects of fire events. The exposed west wall of the 242-A Evaporator is 22 inch thick concrete, which exceeds the requirements of a 4 hr resistive barrier. Reference HNF-14755 Section 3.4.2.2 Gap Analysis No gap Change following Modification None References RPP-SPEC-36062, Section 3.3.2 Gap Analysis No gap	**DOE-HDBK-1169 (10.1)** **DOE-STD-1066**
4 - Resistance to External Events – Natural Phenomena – Seismic		

2004-2 Table 5.1, 242-A K1 Ventilation System Performance Criteria		
Evaluation Criteria	**Discussion**	**Reference**
Confinement ventilation systems should safely withstand earthquakes.	The 242-A Evaporator facility structure and foundation were designed and constructed to withstand a .25g seismic event and have qualitatively been evaluated to meet current PC-2 seismic criteria in TFC-ENG-STD-06. The safety significant facility structure does not include the K1 ventilation system filter housings or the K1 ventilation stack. The concrete slab on which the filter housing and fans are mounted and the underground ductwork may not withstand seismic loadings. The evaporator ventilation systems are not credited in the DSA to perform any safety function during or following a seismic event. Reference HNF-14755 , Section 2.4.2.1.5 Seismic Design and Section 4.4.1.2 System Description, TFC-ENG-STD-06 Gap Analysis There is a gap as the underground ductwork and the above grade portions of the exhaust system may not withstand seismic loading, however the evaporator ventilation systems are not credited in the DSA to perform any safety function during or following a seismic event. Change following Modification The above grade portion of the ventilation exhaust system shall be designed to meet the Performance Category (PC-2) structural loading requirements specified in TFC-ENG-STD-06 except for HEPA filter housings and HEPA filter frames which will meet the applicable requirements of ASME AG-1 References RPP-SPEC-36062 Section 3.2.5 and TFC-ENG-STD-06 Gap Analysis There is a gap. Following the modification, the only portion of the ventilation system that may be vulnerable to seismic event is the underground duct work as it is not within the scope of the modification. However the evaporator ventilation systems are not credited in the DSA to perform any safety function during or following a seismic event.	**ASME AG-1 AA** **DOE O 420.1B** **DOE-HDBK-1169 (9.2), Section 2.4 – Emergency Consideration** **UBC, 1979** **SBC, 1979**
5 - Resistance to External Events – Natural Phenomena – Tornado/Wind		
Confinement ventilation systems should safely withstand tornado depressurization.	The Hanford Site does not have a design-basis tornado. References HNF-14755, Section 2.4.2.1.2 Tornado Loadings Gap Analysis No gap. Change following Modification None Gap Analysis No gap.	**DOE O 420.1B** **DOE-HDBK-1169 (9.2), Section 2.4 – Emergency Consideration**

2004-2 Table 5.1, 242-A K1 Ventilation System Performance Criteria		
Evaluation Criteria	**Discussion**	**Reference**
Confinement ventilation systems should withstand design wind effects on system performance.	The evaporator cell ventilation system was originally designed to withstand 70mph wind without impact to operation or the atmospheric reference header and has been evaluated to meet the PC-2 wind design load requirements of TFC-ENG-STD-06 and DOE-STD-1020-2002. References HNF-14755, Section 4.4.1, TFC-ENG-STD-06 Gap Analysis No gap. Change following Modification The above grade portion of the ventilation exhaust system including anchorages shall be designed to withstand PC-2 wind loads. A "Three-Second Gust Wind Velocity" of 91 mph, importance factor of 1.0, and exposure Category C shall be used for all wind design per TFC-ENG-STD-06. References RPP-SPEC-36062 Section 3.2.5.2, TFC-ENG-STD-06 Gap Analysis No gap.	**DOE O 420.1B DOE-HDBK-1169 (9.2)**
6 – Other NP Events		
Confinement ventilation systems should withstand other NP events considered credible in the DSA where the confinement ventilation system is credited.	Flooding is not considered a credible event for 200 East Area of the Hanford Site. The 242-A Evaporator structure has been evaluated to withstand ashfall loading (20 lb/ft^2) combined with snow loading (20 lb/ft^2). Analysis of the exterior portions of the ventilation system were not found as the criteria was not considered applicable for general service equipment and the evaporator cell ventilation systems are not credited in the DSA to perform any safety function during or following any other NPH event such as ash fall, or snow loads. However, the facility would receive at least two hours notice of significant snow accumulation or ash fall. TF-AOP-013 would trigger evaluation and shutdown of the evaporator if needed. The evaporator can be shut down in 30 minutes. References HNF-14755 Section 4.4.1, TF-AOP-013 Gap Analysis No gap. Change following Modification Snow loading per TFC-ENG-STD-06 is specified in the procurement specification. This will bound the ashfall loading. References RPP-SPEC-36062 Section 3.2.5.3, TFC-ENG-STD-06 Gap Analysis No gap.	**DOE O 420.1B DOE-HDBK-1169 (9.2), Section 2.4 – Emergency Consideration**
7 – Range Fires/Dust Storms		

2004-2 Table 5.1, 242-A K1 Ventilation System Performance Criteria		
Evaluation Criteria	**Discussion**	**Reference**
Administrative Controls should be established to protect confinement ventilation systems from barrier threatening events.	The 242-A Evaporator Fire Protection Program limits the combustible growth around the evaporator building such that an external fire would have very limited effects on the facility. The areas external to the building are sprayed with pre-emergent herbicide in the fall and with post-emergent herbicide in the spring. The portion of the ventilation system that is external to the building is surrounded by a chain link fence to prevent transient combustibles (like tumbleweeds) from being blown into the area. The facility performs daily inspections of this area so any combustibles that are caught in the fence can be removed. There are no ignition sources adjacent to the filter frames. The site's emergency procedures and the facility's Event Response Program would further limit the effects of external barrier threatening events. If a range fire is determined to be headed towards site facilities, TF-AOP-007 will trigger evaluation and shutdown of the evaporator if needed. The evaporator can be shut down in 30 minutes. Similarly TF-AOP-008 covers dust storms. The evaporator cell ventilation systems are not credited in the DSA to perform any safety function during or following a range fire event. References HNF-14755, Section 3.4.2.2.4, TF-AOP-007, TF-AOP-008, TF-OR-A-02 Gap Analysis No gap. Change following Modification None. Gap Analysis No gap.	**DOE O 420.1B**
8 – Testability		
Design supports the periodic inspection & testing of filters and housing, and test & inspections are conducted periodically.	Each HEPA filter bank has two ½" quick disconnect type test connections for performance testing with aerosol. In-place leak testing is performed for this HEPA filter system in accordance with Site Engineering Standards. In-place leak testing of HEPA filter installation is performed in accordance with Maintenance Procedure 3-VBP-656, "242-A Evaporator HEPA Filter In-Place Leak Test (Aerosol Test)". In-place leak testing is performed annually to detect deterioration of filters, gaskets or other causes that could result in leaks. Testing is also done in a manner that will detect airflow that may bypass HEPA filters. The HEPA filters are replaced when needed based on results of testing. References RPP-16922 Section 14.7.3, 3-VBP-656 Gap Analysis There is a gap as the current design does not include test connections that allow the HEPA filter banks to be tested individually. Change following Modification The new filter housing will be fitted with test sections that allow for HEPA filter banks to be tested individually. The filter housings/test sections shall be tested for air-aerosol mixing uniformity in accordance with the requirements of ASME N510, Section 9. Qualification testing of sampling manifolds shall be conducted in accordance with ASME AG-1, non-mandatory Appendix HA-D. Qualifications testing of challenge aerosol injection manifolds shall be performed in accordance with ASME N510, Section 9. Acceptance criteria shall be as given in ASME N510, Section 9. References RPP-SPEC-36062, Section 4.1.3 Gap Analysis No gap.	**DOE-HDBK-1169 (2.3.8), ASME AG-1, ASME N510**

2004-2 Table 5.1, 242-A K1 Ventilation System Performance Criteria		
Evaluation Criteria	**Discussion**	**Reference**
Instrumentation required to support system operability is calibrated.	The K1 ventilation instrumentation and control system (VCS) is equipped with manifold valves with calibration ports. A PM program and calibration frequencies have been established for the 242-A Evaporator K1 Ventilation instrumentation. M&TE is used for loop calibrations. Gap Analysis No gap References H-2-830594, Sht. 2 and Sht. 5 RPP-16922, Section 5.1.1 RPP-16922, Table 14-2 Change following Modification None Gap Analysis No gap.	**DOE-HDBK-1169 (2.3.8), ASME AG-1, ASME AG-1**
Integrated system performance testing is specified and performed.	The K1 ventilation system is simple with regards to equipment and instruments. Functional testing of the ventilation interlocks were performed as part of the testing following installation in 2008. A PM program and calibration frequencies have been established for the ventilation instrumentation and interlocks. Reference 242-A-HVAC-TRR-1.0 Gap Analysis No gap. Change following Modification New instruments will be calibrated and the system will be tested prior to receipt. After delivery and installation, the system, including instrumentation and interlocks, will be tested again via Operational Acceptance Test procedure (OAT). The OAT will be prepared and performed to Project Start-Up and Testing Procedures (i.e., TFC-PRJ-SUT-C-02 and TRC-PRJ-SUT-C-03). References RPP-SPEC-36062, Section 5.4 and Section 5.6.6.8 Gap Analysis No gap.	**DOE-HDBK-1169 (2.3.8)**
9 – Maintenance		
Filter service life program should be established.	The HEPA filter service life program for the 242-A Evaporator conforms to the requirements of the Hanford Site Air Operating Permit and TFC-ENG-STD-07, Ventilation System Design Standard. For the 242-A Evaporator K1 ventilation systems, these requirements are implemented via the Preventative Maintenance (PM) Program. The HEPA filter service life program ensures that filters are tested prior to installation and annually during service. During operation, HEPA filter differential pressure is monitored for indications of loading. There are no toxic materials or acids in the airstream that will damage the HEPA filters. References PMs EE-02290 and EE-02291 (PMs and PM history can be found in the TOC CHAMPS PM system), TFC-ENG-STD-07 Gap Analysis No gap. Change following Modification None Gap Analysis No gap.	**DOE-HDBK-1169 (3.1 & App C)**

2004-2 Table 5.1, 242-A K1 Ventilation System Performance Criteria		
Evaluation Criteria	**Discussion**	**Reference**
	10 - Single Failure	
Backup electrical power shall be provided to all critical instruments and equipment required to operate and monitor the confinement ventilation system.	The K1 Ventilation systems are supplied with an alternate power supply (e.g. backup diesel generator). The K1-5-2 and associated controls are supplied by the backup power. The K1 ventilation systems (including backup power) are not credited in the DSA to perform any safety function during a loss of power event. References HNF-14755, Section 2.6.1.1 and Section 2.8.1. Gap Analysis No gap Change following Modification None Gap Analysis No gap.	**DOE-HDBK-1169 (2.2.7)**
	11 - Other Credited Functional Requirements	
Address any specific functional requirements for the confinement ventilation system (beyond the scope of those above) credited in the DSA.	The 242-A Evaporator K1 ventilation system is not credited with any safety function in the DSA. References HNF-14755, Section 3.4.2.2. Gap Analysis No gap Change following Modification None Gap Analysis No gap.	**10 CFR 830 Subpart B**

Attachment 3

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