BJC/OR-2866

ACTIVE CONFINEMENT SYSTEM EVALUATION SUMMARY REPORT FOR DNFSB 2004-2

PORTABLE UNITS, OAK RIDGE TENNESSEE

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APPROVALS

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Portable Units, Oak Ridge, Tennessee)

[BJC/OR-2866]

[July 31, 2007]

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ACRONYMS

BJC	Bechtel Jacobs Company LLC
DID	Defense In Depth
DCS	Distributed control system
DNFSB	Defense Nuclear Facilities Safety Board
DOE	U.S. Department of Energy
DSA	Documented Safety Analysis
FET	Facility Evaluation Team
HEPA	High-efficiency particulate air
HVAC	High-voltage alternating current
LLLW	Liquid Low-Level Waste
MVST	Melton Valley Storage Tanks
MVSTA	Melton Valley Storage Tanks Annex
ORNL	Oak Ridge National Laboratory

1. INTRODUCTION

1.1 FACILITY OVERVIEW

Newly-generated drums of TRU waste are required to have vents to relieve the potential buildup and pressurization from gas generation and a sampling port for headspace gas sampling. The MVSWSF TRU facilities contain a large number of legacy waste drums that are not vented. These drums must be vented and the headspace gas sampled for explosive gases and total Volatile Organic Compounds (VOCs) before receipt at the TRU Waste Processing Facility. They are brought into compliance with these requirements through the vent and purge process, which is performed inside a portable unit using a remotely actuated pneumatic driver unit configured to install the filter vents/sample ports. The location for performing this activity is in the portable unit which can be relocated to each storage facility to minimize TRU waste drum handling. The portable unit is of robust construction and features explosion proof electrical equipment, HEPA filtered ventilation, and dry chemical fire suppression. The portable unit has previously been used for missions such as disposition of shock sensitive materials and repackaging of radiological and mixed wastes. There are no residual materials remaining in the portable units from these activities other than minor surface contamination.

This activity is categorized as a Category 2 activity since the drums with the highest inventory of radiological material are greater than Category 2. The portable unit is not treated as a separate facility in the DSA because of its proximity to the facilities where the drums are currently stored.

1.2 CONFINEMENT VENTILATION SYSTEM/STRATEGY

The portable units consist of structures similar in construction to a Sealand container mounted atop a heavy duty trailer (Figs. 1. and 2.). The portable units are constructed of heavy gauge steel and fire resistant gypsum wallboard. The roof/ceiling assembly is permanently attached to the exterior walls. The portable units have approximate dimensions of 15 ft 10 in. × 9 ft. 6 in.

Wall construction consists of a 2-hour, fire-rated non-combustible material. The interior floor is a fiberglass grating made with fire-retardant resin, which is corrosion resistant. Each unit has a built-in 7-in. deep secondary containment structure beneath the floor grating. The sump is constructed of 2-hour, fire-rated non-combustible materials. The sump walls are heavy-gauge steel, continuously welded to the sump floor. Internal spill capacity is 500 gal per unit.

The portable units are not designed to withstand significant natural phenomena hazard events. The portable units are not likely to be used during inclement weather for personnel safety considerations. Seismic events are unpredictable but would at worst tip the portable unit over.

An exhaust fan and HEPA filter are mounted on the portable unit and draw air from the compartment (Fig. 3.). This provides some confinement of radiological hazards that could be released in the enclosure.

The portable units are approximately fifteen years old. They were originally procured to facilitate field sampling activities but have been used for a variety of activities, such as shock sensitive chemical treatment. The only modifications made to the unit for its current use was to remove non-spark proof equipment and to add rails and air lines to support the vent and purge operation. The only scenarios in the DSA that are exclusively associated with this system are those tied to operational upsets during the vent

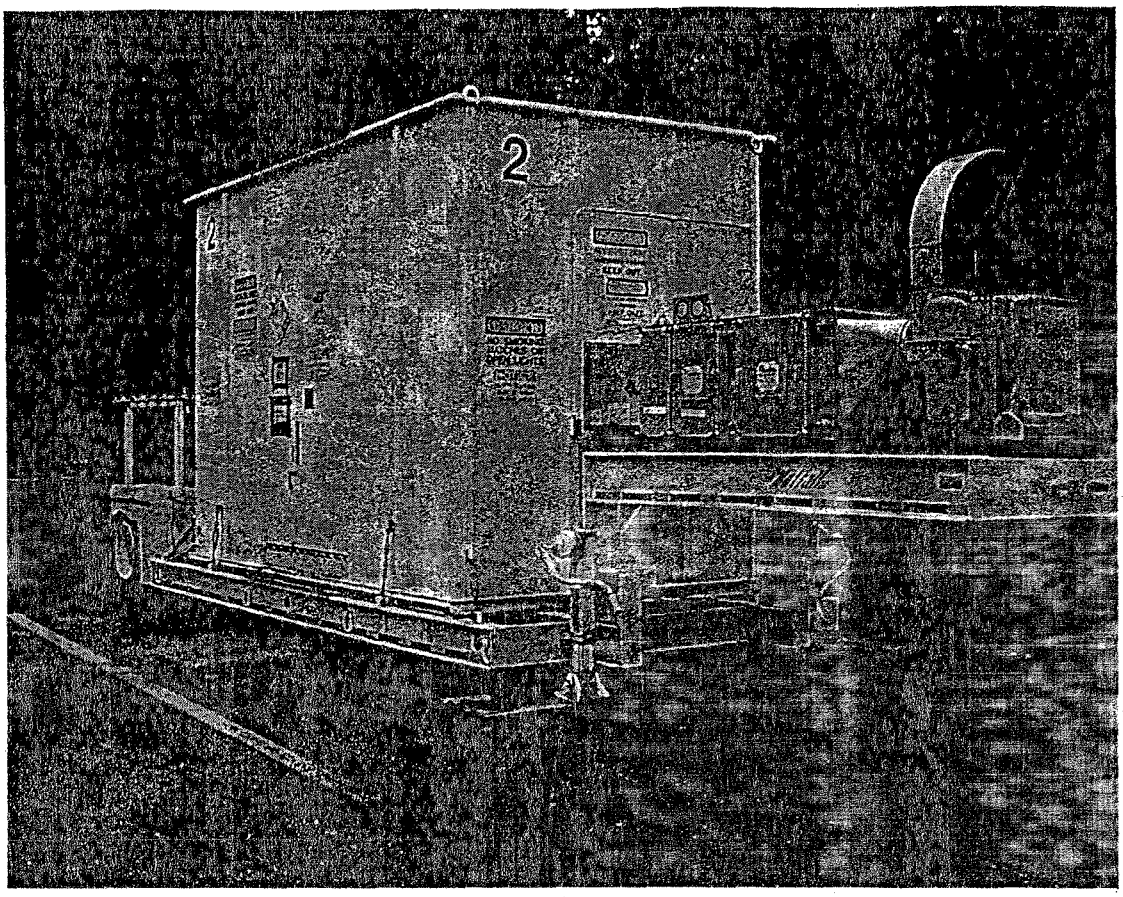

Fig. 1. Portable unit

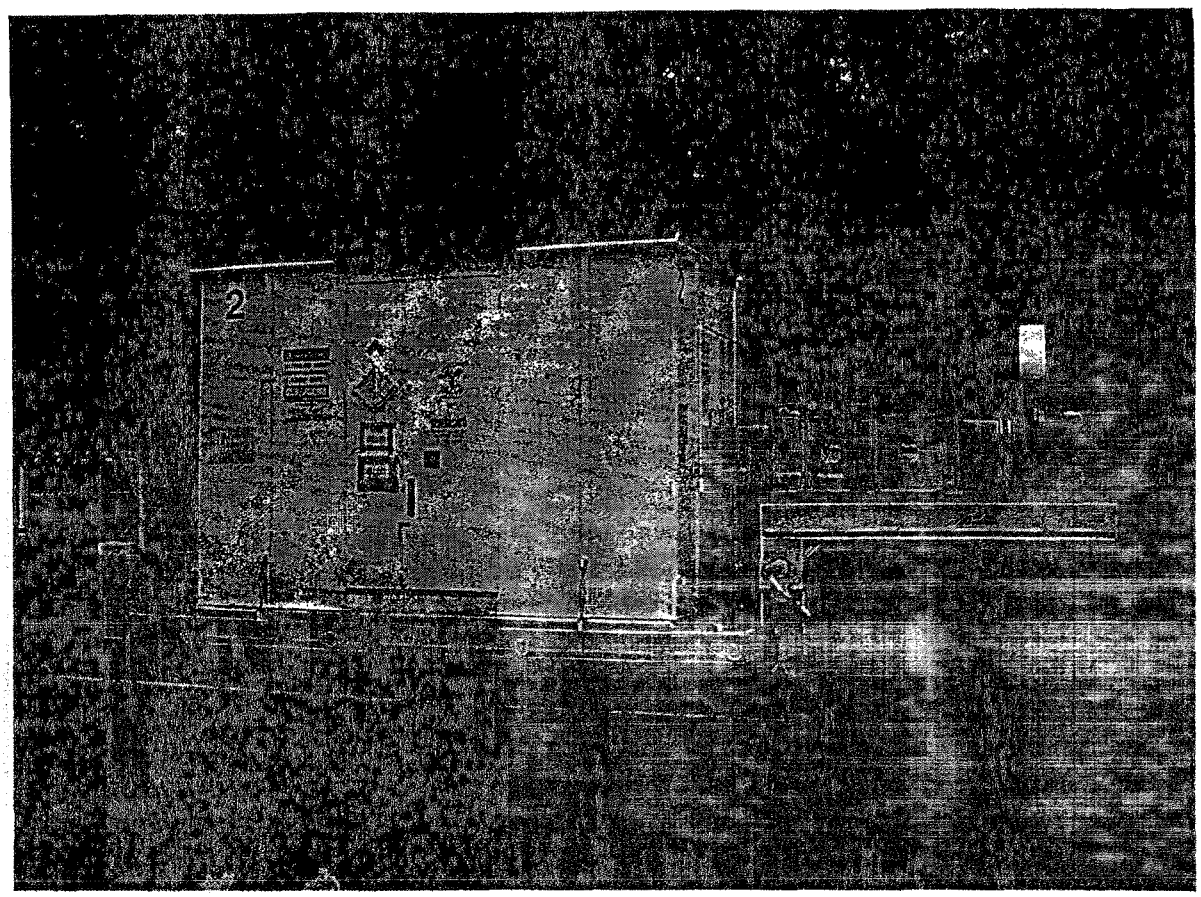

Fig. 2. Portable unit.

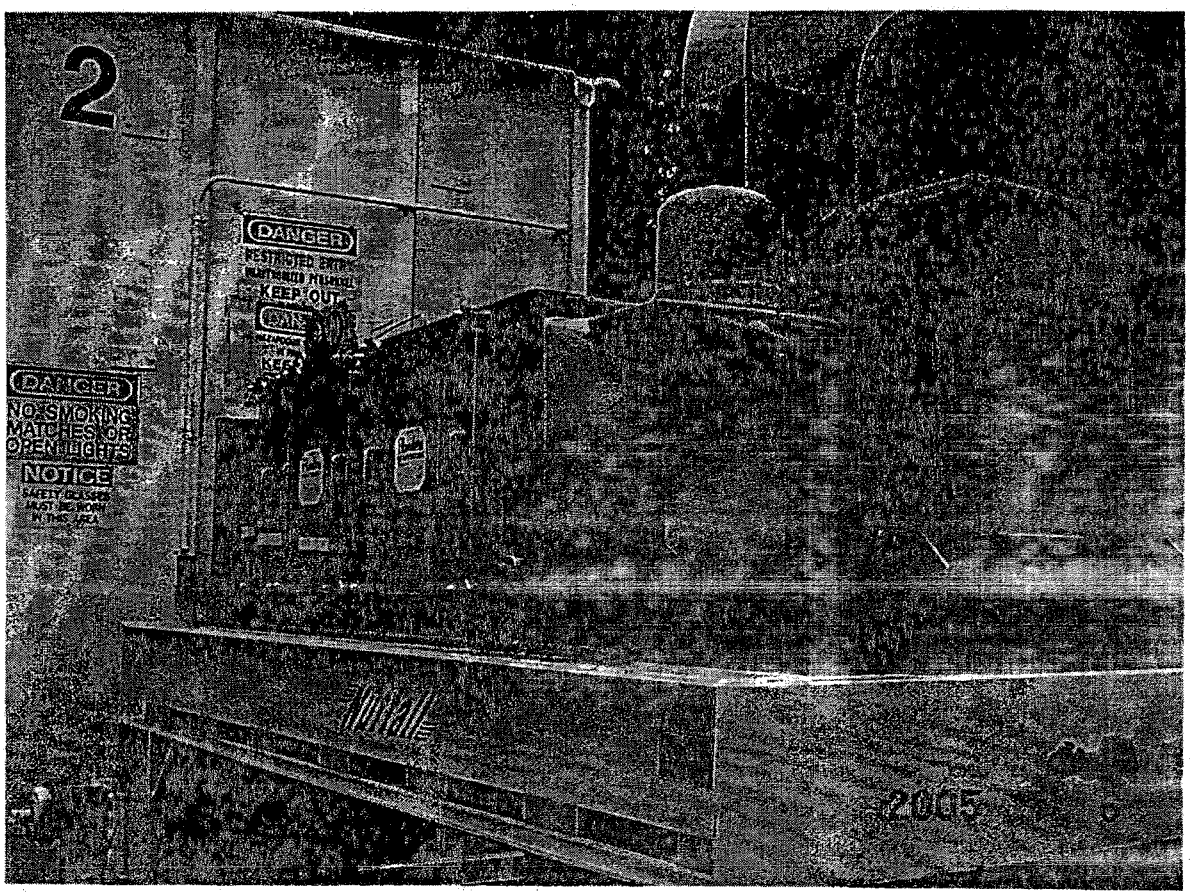

Fig. 3. Portable unit HEPA filter system.

and purge process. These events are primarily deflagration and fire, as they can be single container events. All other events typically involve multiple drums and, therefore, default to those analyzed under the storage facility the waste is delivered from. This includes natural phenomena.

1.3 MAJOR MODIFICATIONS

There are no major modifications or mission changes planned for this facility at this time.

2. FUNCTIONAL CLASSIFICATION ASSESSMENT

2.1 EXISTING CLASSIFICATION

The system is currently classified as a safety significantsystem in the DSA.

2.2 EVALUATION

The system was evaluated per Deliverable 8.5.4 and 8.7 of the Implementation Plan for DNFSB 2004-2, *Ventilation System Evaluation Guidance for Safety-Related and Non-Safety –Related Systems.* Table 4-3 from the guidance was completed, provides the information collected for the classification review, and is attached as Appendix A.

The determination of bounding unmitigated consequences presented in the DSA was reviewed by the FET. It was determined that the quantitative dose consequences are determined in accordance with DOE-STD-3009-94 and do not challenge the evaluation guideline (it is noted that the analyses of fire and deflagration included in the DSA have been determined to be conservative relative to the recently issued standard (DOE-STD-5506-2007) for evaluating TRU waste).

The HEPA filter system is identified in the DSA as a DID control that is elevated to a safety significant classification but is not credited for significantly reducing event consequences. The ventilation system is not individually credited for reducing event consequences to a lower risk bin. Specific performance criteria include maintaining DP across HEPA filters and are included in the TSR as an LCO. Quantitative filtering efficiency criteria are not credited in the DSA. HEPA filter efficiency testing is based on Safety Management Program requirements. The control suites identified in the DSA focus on preventative measures and inventory limits as well as the portable unit structure and drum lid restraints to minimize releases to reduce risk associated with identified events to acceptable levels.

2.3 SUMMARY

The FET concluded that the portable unit HEPA filtered ventilation system is appropriately and conservatively classified as safety significant.

3. SYSTEM EVALUATION

3.1 IDENTIFICATION OF GAPS

The system was evaluated per Deliverable 8.5.4 and 8.7 of the Implementation Plan for DNFSB 2004-2, *Ventilation System Evaluation Guidance for Safety-Related and Non-Safety –Related Systems.* Table 5.1 from the guidance was completed, provides the system evaluation, and is attached as Appendix B. The portable unit ventilation system was evaluated against the safety significant criteria defined in the evaluation guidance document.

The following gaps were identified:

- Lack of filters on air inlets,
- No local alarm on system to indicate operability issues, and
- No real-time monitoring for filter breakthrough.

Based on the DSA, the HEPA filter system is identified as a DID control that is elevated to a safety significant classification and is not credited for significantly reducing event consequences. Therefore, these criteria were not considered to be mandatory by the FET.

3.2 GAP EVALUATION

3.2.1 Lack of filters on air inlets.

Inlet air enters the portable unit through inlet louvers near the floor and through unsealed joints. Material in-leakage is not considered to be a concern. The DSA does not credit the portable unit and ventilation system for providing significant confinement. The physical volume of the portable unit will minimize pressurization of the unit in the event of a deflagration. Material released in the event of a fire in the unit will preferentially be exhausted through the ventilation system. Based on these aspects of the portable unit and ventilation system, the identified gap is determined to be acceptable.

3.2.2 No local alarm on system to indicate operability issues.

The portable unit HEPA filtered ventilation system is not equipped with alarms that would indicate filter DP problems, fan failure, etc. The lack of a local alarm indicating operability issues is addressed by the fact that the unit is operated locally and facility workers are in attendance outside the portable unit and next to the HEPA filter system the entire time the unit is operating. Operational issues would be identified during operation. Based on these aspects of portable unit operation as compensatory measures, the identified gap is determined to be acceptable.

3.2.3 No real-time monitoring for filter breakthrough.

Normal operations in the portable unit do not result in release of significant levels of contamination. However, in accordance with the Radiological Protection Safety Management Program, a filter paper air monitor is positioned on the stack exhaust and is routinely monitored during operation. This would indicate breakthrough that may not be apparent by a drop in DP on the gages. Normal operating procedures require video surveillance of remote drum operations which would alert operators to an accident inside the unit (deflagration, fire) and initiate response actions. Also, because the system is not run continuously, the

filter DP gages are read after startup and before remote operations in the unit commence. Based on these aspects of portable unit operation as compensatory measures, the identified gap is determined to be acceptable.

3.3 MODIFICATIONS AND UPGRADES

No modifications are recommended at this time. The criteria not met are not considered to be mandatory based on the DSA. The identified gaps are considered acceptable due to measures that compensate for the missing aspects. In addition, the current drum venting campaign is now expected to be completed in less than three years.

4. CONCLUSION

In conclusion, the HEPA Filter System in the Portable Unit is conservatively managed as a safety significant system even though it is not credited for significantly reducing the consequences of the analyzed events in the DSA. While there are three gaps identified from the ventilation evaluation criteria comparison, the associated criteria were not considered mandatory and there are adequate compensatory measures to address the issues.

5. REFERENCES

ACGIH, *Industrial Ventilation: A Manual of Recommended Practice, 20th ed.*, 1988.

Procedure No. WD-OP-X501.51, *CH-TRU Container Vent and Purge Operation*, Rev. 1

APPENDIX A

Table 4-3 Data Collection Table

Confinement Documented Safety Analysis Information										
Facility: Portable Units			**Hazard Category** 2					**Performance Expectations**		
Bounding Accidents	**Type Confinement**		**Doses** Bounding Unmitigated/ Mitigated	**Confinement Classification**			**Function** (see list)	**Functional Requirements**	**Performance Criteria**	**Compensatory Measures**
	Active	**Passive**		**SC**	**SS**	**DID**				
App. C – VP-2a Unvented waste container fire following deflagration during operator activity (punching/venting/ purging of container)	X		<u>Unmitigated</u> Public <1 rem Collocated Worker >100 rem <u>Mitigated</u> Public <1 rem Collocated Worker <25 rem		X		b. confinement for collocated worker protection d. In-facility worker protection	Reduces the consequences of a fire or deflagration in the portable unit.	The PROCESS shall be OPERABLE when: (1) the as-read differential pressure (DP) across the pre-filter is greater than or equal to 0.05 in. w.g. but less than or equal to 0.75 in. w.g., as measured with the portable unit doors open and closed; (2) the as-read differential pressure (DP) across the HEPA filter is greater than or equal to 0.5 in. w.g. but less than or equal to 3.0 in. w.g., as measured with the portable unit doors open and closed; and (3) the measured efficiency of the HEPA filter system is greater or equal to 99%.	Additional preventive design features are the Drum Penetrator Tip (non-sparking), the Purging System (compatible with flammable gases) and Grounding mats (static discharge) Additional mitigative design features are the Lid Restraint (prevent lid becoming a missile).

Table 4-3 Data Collection Table Explanations for the Portable Unit

Column 1 – Bounding Accident

A deflagration followed by a fire during the venting and purging of an unvented container was considered the bounding accident for the operation.

Column 2 – Type Confinement

The Portable Unit HEPA Filter System is an active HEPA filtered exhaust system and has associated Limiting Conditions for Operation controls. (Ref.1, Section 4.4.2)

Column 3 – Doses (Bounding Unmitigated and Mitigated)

The unmitigated estimate of the radiological consequences to the public was <1 rem but the dose to the collocated worker and worker was considered >100 rem. The mitigated dose to the collocated worker and worker were reduced to <25 rem but this was primarily due to the confinement structure itself and the use of lid restraints on the drums. This information came from a scoping calculation that supported the qualitative analysis portions of the DSA. The scoping calculation used 95% meteorology, the methodology from 3009, and is consistent with the new TRU waste standard that is currently in DOE review. A scoping calculation was considered sufficient since the public consequences did not challenge the evaluation guideline.

Column 4 – Confinement Classification

The system is classified as a SS SSC. (Ref. 1, Chapter 4)

Column 5 - Function

The safety function is to mitigate the consequences of a deflagration or fire in the portable unit. (Ref. 1, Section 4.4.2.1)

Column 6 – Functional Requirements

The operability limits for the HEPA filter system are established to achieve optimum performance when needed to support vent/sample port installation or purging drums of TRU waste. The combination of HEPA filter efficiency and limits on differential pressure across the pre-filter and filter ensure that releases will be adequately filtered. Since the HEPA filter system is a DID control that is not credited for reducing event consequences, no specific performance or filtering criteria are established. (Ref.1, Section 4.4.2.3)

Column 7 – Performance Criteria

The Portable Unit HEPA Filter System consists of the following components (in direction of air flow):

- Inlet duct with test port;

- Pre-filter section with nominally 23-3/8" x 23-3/8" x 1-3/4" pre-filter and a 0 – 1 inch w.g. Magnehelic pressure gage;
- HEPA filter section with nominal 24"x24"x 11-1/2" HEPA filter, a 0 – 6 inch w.g. Magnehelic gage, and test ports;
- Adsorber section suitable for nominal 24" x 24" x 18" adsorber and test ports;
- Duct transition to fan inlet;
- Fan; and
- Discharge duct with test port.

The PROCESS shall be OPERABLE when:

(1) the as-read differential pressure (DP) across the prefilter is greater than or equal to 0.05 in. w.g. but less than or equal to 0.75 in. w.g., as measured with the portable unit doors open and closed;

(2) the as-read differential pressure (DP) across the HEPA filter is greater than or equal to 0.5 in. w.g. but less than or equal to 3.0 in. w.g., as measured with the portable unit doors open and closed; and

(3) the measured efficiency of the HEPA filter system is greater or equal to 99%.

The HEPA filter DP OPERABILITY limits were established as follows. The minimum infiltration rate recommended by *Industrial Ventilation* (ACGIH 1988) for confinement of this process is 300 ft/min. This would correspond to a flow rate of approximately 400 cfm. According to the fan curve, the fan static pressure at 400 cfm is 4.2 in. w.g. Since the majority of the system DP is filter resistance, it was assumed that the combined filter DP at the minimal confinement flow rate (400 cfm) was 4.0 in. w.g.

Therefore, the upper limit on HEPA filter DP was established at 3.0 in. w.g. and the upper limit on pre-filter DP was established at 0.75 in. w.g. These limits take into account the maximum instrument error for the HEPA and prefilter of 0.2 and 0.04 in. w.g., respectively.

The purpose of establishing a lower limit on HEPA filter DP is to signal the possibility of a breach in the HEPA filter or an obstruction to flow, i.e., partial blockage of the inlet screen inside the portable unit due to something sucked against it or failure or closing of the inlet damper. Standard HEPA filters such as these are designed to operate at 1,000 cfm and a clean DP of less than 1.0 in. w.g., (typically 0.7 to 0.9 in. w.g.). Therefore, since the clean filter flow rate of this system is greater than 1,000 cfm, a HEPA filter DP of less than 0.5 would indicate either a breach in the HEPA filter, or an obstruction to flow, either of which could compromise confinement.

The minimum HEPA filter efficiency was established to ensure adequate confinement for all anticipated releases, while allowing for a slight reduction in system efficiency typical of in-situ measurements. The HEPA filters have been tested at the DOE Filter Test Facility, and are assured to have a minimum efficiency of 99.97% when tested with an aerosol of essentially mono-dispersed 0.3 micron particles. In accordance with ASME N510, in-place testing of HEPA filters is done with a polydispersed aerosol that has a wide range of particle sizes and should not be confused with the 0.3 micron monodisperse DOP (dioctyl phthalate) aerosol used for efficiency testing in the DOE Filter Test Facility. Some reduction in efficiency is typically observed during in-situ testing owing largely to an imperfect seal around the filter. A lower limit of 99% will allow for typical field conditions, while still accomplishing the required safety function described in the DSA. Since no credit is taken for consequence reduction in the DSA events, this is an acceptable level for the filters.

The HEPA filter system was not designed to be operable during natural phenomena events or after a fire. It is anticipated that the filter system will be plugged by the chemical fire protection media and the smoke particulate such that the system will no longer be able to filter air. The confinement credit given at that point is merely keeping radioactive particulate within the portable unit by not providing an escapeavenue.

Column 8 – Compensatory Measures

The filter system was not designed to provide the normal coverage during fire and natural phenomena releases. However, primary confinement of the radiological material is performed by the drum lid restraint (minimize the amount of radiological material released from the drum confines) and the portable unit structure (minimize the release outside the confines of the structure). The HEPA Filter System is considered part of this latter component but only at a second level. The filters may plug during the bounding event from soot and the dry chemical fire protection system. The plugged filter would still act as a deterrent to the release of radioactive material from the unit. Compensatory measures, as defined in the guidance, are not considered necessary for the operation of the portable units. A full description of the process follows.

The portable unit is a primary location for performing the drum venting and purging operation in preparation for transfer to the TRU Waste Processing Facility. There are two identical units. Either unit can be moved to each storage facility to limit travel time and distance for drums. The portable unit is of robust construction and features explosion proof electrical equipment, HEPA filtered exhaust, and dry chemical fire suppression. In-process drums can be placed in storage facility staging areas.

The portable unit structure is similar in construction to a Sealand container and mounted atop a heavy duty trailer. The portable unit is constructed of heavy gauge steel and fire resistant gypsum wallboard. Newly-generated drums of TRU waste are required to have vents that relieve the potential pressure from gas generation and a sampling port for headspace gas sampling. The MVSWSF TRU facilities contain a large number of legacy waste drums that are not vented or if vented do not have a sample port. These drums must be vented and the headspace gas sampled for hydrogen and total Volatile Organic Compounds (VOCs) before receipt at the TRU Waste Processing Facility. They are brought into compliance with these requirements through the vent and purge process. Installation of the vent and sampling ports will only be performed inside the portable unit with a remotely activated device. A lid restraint is required during this operation if the drum is considered unvented. The device is air or nitrogen driven. Initial sampling will occur in the portable unit but additional headspace sampling may occur in any TRU storage facility that contains drums with sampling ports, i.e., 7572, 7574, 7879, or 7883.

Wall construction consists of a 2-hour, fire-rated noncombustible material. The interior floor is a fiberglass grating made with fire-retardant resin, which is corrosion resistant. Each unit has a built-in 7-in. deep secondary containment structure beneath the floor grating. The sump is constructed of 2-hour, fire-rated noncombustible materials. The sump walls are heavy-gauge steel, continuously welded to the sump floor. Internal spill capacity is 500 gal per unit

An exhaust fan and a HEPA filter housing are mounted on the portable unit and draw air from the compartment. An engineering evaluation consisting of air flow measurement and fan curve analysis was performed on Unit 1 (which is identical to Unit 2). The following measurements were obtained:

- Flow Rate: 1,212 cfm

- HEPA filter DP: 0.7 in. w.g.
- Infiltration Velocity: 1,000 fpm (approx. measured at the intake louvers)

This provides a level of confinement for radiological particulate that could be released in the enclosure. (Ref. 1, Section 4.4.2.2)

APPENDIX B

Table 5.1 Ventilation System Performance Criteria

Evaluation Criteria	Safety Significant	Evaluation Criteria Explained	System Capabilities and Characteristics	Reference
Pressure differential should be maintained between zone and atmosphere.	Applies	Per DOE-HNDBK-1169, Table 2.1: • Primary: -0.3 to -1.0 in. w.g. • Secondary: -0.03 to -0.15 in. w.g. • Tertiary: -0.01 to -0.15 in. w.g. These are guidelines to be used in the absence of facility design bases or site-specific standards. Greater differential pressures (DPs) are acceptable if compatible with system design, construction, and capability. Section 2.3.1 states that system flow (and DPs) may be reduced during periods of non-operation.	During operation, the system maintains a slight negative pressure in the secondary confinement structure, which is the portable unit. (The primary confinement structure is the drum being vented or purged within the portable unit.) The secondary confinement differential pressure (DP) is not monitored directly. It is monitored indirectly by reading the pre- and HEPA filter DP gages, which are TSR-credited instruments recorded each day of operation. It has been determined through direct flow measurement and analysis of the fan's characteristic curve that the rate of inflow into the portable unit will be approximately 800 ft/min when both filters are loaded to their TSR limits and the doors are closed. At this worst-case condition, the approximate secondary confinement DP may be inferred from Ref. 1, Table 7-1 to be 0.11 in. w.g., which satisfies the evaluation criteria.	DOE-HDBK-1169 (2.2.9), ASHRAE Design Guide
Materials of construction should be appropriate for normal, abnormal, and accident conditions	Applies	Per DOE-HNDBK-1169, Section 2.2.5: • Materials exposed to a corrosive atmosphere must be suitable for that environment • Air treatment systems, such as scrubbers or air washers should be considered to reduce the corrosive atmosphere • Electronic components must be environmentally qualified for the intended application For ductwork, Section 4.3.3 recommends all-welded construction using stainless steel or carbon steel coated for corrosion resistance.	The ductwork and filter housing is constructed of all welded, stainless steel. The fan is flanged-and-bolted, painted carbon steel. The air stream is non-corrosive outside air. The fan and motor starter are explosion proof. The motor is totally enclosed, fan cooled. The materials of construction satisfy the evaluation criteria for normal, abnormal, and accident conditions.	DOE-HDBK-1169 (2.2.5), ASME AG-1

Table 5.1 Ventilation System Performance Criteria (cont.)

Evaluation Criteria	Safety Significant	Evaluation Criteria Explained	System Capabilities and Characteristics	Reference

System should maintain confinement integrity during normal, abnormal, and accident conditions	Applies	Per DOE-HNDBK-1169, Section 2.4:
		• For all conditions and design basis accidents (DBAs) that the system is expected to remain functional:
		  • Components must be capable of withstanding the differential pressures, heat, moisture, and stress with minimum damage and loss of integrity
		  • Provisions must be made for the probable occurrence of power and equipment (particularly fan) failures, such as redundant fan/fan motors and alternate power sources.
			The DSA does not credit the system to operate during abnormal or accident conditions, (except duringa drum deflagration, as described in section on credible fire events below). The TSR requires the system be operating only during drum venting/purging. All other times the system may be off. The system is turned off at the end of each workday. The system has no alternate power source or redundant components (other than the back-up Portable Unit). Power or component failure would be an abnormal condition, requiring exit from OPERATION MODE, and possible evacuation. The system was not designed or credited to operate during an electrical power or component failure.
			
			No formal evaluation of the system has been performed to determine its ability to maintain confinement integrity during normal, abnormal, and accident conditions.
			
			The intent of the evaluation criteria is satisfied.
				DOE-HDBK-1169 (2.4), ASHRAE Design Guide

Table 5.1 Ventilation System Performance Criteria (cont.)

Evaluation Criteria	Safety Significant	Evaluation Criteria Explained	System Capabilities and Characteristics	Reference
System should have appropriate filtration to minimize release	Applies	Per DOE-HNDBK-1169, Section 2.2.9, primary confinement zones require: • High efficiency filters, preferably HEPAs, in air inlets; and • Independently testable HEPA filter stages in the exhaust. The number of stages required is determined by safety analysis. HEPA filters must be tested in-place at a prescribed frequency per ASME AG-1.	System employs single-stage HEPA filtration on exhaust flow as assumed in the safety analysis. In-place efficiency tests were conducted following installation and annually per ASME N510, as required by the TSR. The minimum efficiency for the in-place test is established in the TSR as 99%. The TSR HEPA filter DP limits are 0.5 and 3.0 inches w.g. Inlets are not filtered; therefore, the evaluation criteria are not entirely satisfied.	DOE-HDBK-1169 (2.2.1), ASME AG-1
Provide system status instrumentation and/or alarms	Applies	Per DOE-HNDBK-1169, Section 2.4.2: • Visible and audible alarms should be provided, both locally and at a central control station, to signal the operator when a malfunction to the system has occurred. In addition, indicator lights to show the operational status of fans and controls in the system should be provided in the central control room.	The system is designed and intended to be operated locally, therefore no remote alarm or control is provided. The system status instrumentation is the filter DP gages. These gages have no alarm indication. There is no need for a central control room, indicator lights, or alarms since the venting/purging process requires the operator to be at the portable unit. The operator would hear or see any changes in system operation due to a malfunction or abnormal condition. The evaluation criteriaare not entirely satisfied since there is no local alarm to signal a malfunction.	DOE-HDBK-1169, ASHRAE Design Guide (Section 4), ASME AG-1
Interlock supply and exhaust fans to prevent positive pressure differential	Applies	No explanation required.	Not Applicable. Facility does not have supply fans.	DOE-HDBK-1169 ASHRAE Design Guide (Section 4)

Table 5.1 Ventilation System Performance Criteria (cont.)

Evaluation Criteria	Safety Significant	Evaluation Criteria Explained	System Capabilities and Characteristics	Reference
Post-accident indication of filter break-through	Applies	While the reference does discuss post-accident monitoring, it does not discuss post-accident indication of filter break-through.	Post-accident indication of filter break-through would be indicated by a significant decrease in filter DP from the previous reading. Additionally, the lower TSR limits on these filter DP gages were established with the intent of indicating filter break-through. A CAM with alarm located within the enclosure would alert the operator when the filter may encounter radiological contamination. The system does not have a real-time indication of filter break-through. However, a break-through would likely be observed by the operator as a sudden change in fan sound frequency and perhaps filter media and dust seen discharging from the fan outlet. Although not a real-time indication of filter break-through, an air-monitor is operated at the stack whenever the system is operating. The filter paper is analyzed every 72 hours. The intent of the evaluation criteria is not satisfied since the system has no real-time indication of filter break-through.	DNFSB/TECH-34

Table 5.1 Ventilation System Performance Criteria (cont.)

Evaluation Criteria	Safety Significant	Evaluation Criteria Explained	System Capabilities and Characteristics	Reference

Reliability of control system to maintain confinement function under normal, abnormal, and accident conditions	Applies	Per DOE-HNDBK-1169, Section 2.4:
		• For all conditions and design basis accidents (DBAs) that the system is expected to remain functional:
		  • Control system components must be capable of withstanding the environmental conditions with minimum damage and loss of integrity and they must remain operable long enough to satisfy system objectives.
		  • Provisions must be made for the probable occurrence of power and equipment failures, such as redundant critical control components and alternate power sources.
			The DSA does not credit the system to operate during abnormal or accident conditions, (except during a drum deflagration, as described in section on credible fire events below).
			
			The system is started and stopped by a manual onoff switch. A manual damper is available to adjust flow if necessary. These controls are not affected by adverse environmental conditions.
			
			The system has no alternate power source or redundant components (other than the backup Portable Unit). Power or component failure would be an abnormal condition, requiring exit from OPERATION MODE, and possible evacuation. Thesystem was not designed or credited to operate during an electrical power or component failure.
			
			The intent of the evaluation criteria is satisfied.
				DOE-HDBK-1169 (2.4)

Control components should fail safe	Applies	DOE-HNDBK-1169 states: • Even if a system can be shut down in the event of an emergency, protection of the final filters is essential to prevent the escape of contaminated air to the atmosphere or to allow personnel to occupy spaces of the building (Section 2.4) • Automatic flow control dampers, if possible, should be installed so that in the event of a failure, they fail in place or open (Section 6.5.3.3)	The DSA does not credit the system to operate following a failure of a control component. The manual controls described above will fail in place However, no formal evaluation of the control system has been performed. Per the TSR personnel are not permitted inside the enclosure during drum venting/purging. The intent of the evaluation criteria is satisfied.	DOE-HDBK-1169 (2.4)

Table 5.1 Ventilation System Performance Criteria (cont.)

Evaluation Criteria	Safety Significant	Evaluation Criteria Explained	System Capabilities and Characteristics	Reference
System should withstand credible fire events and be available to operate and maintain confinement	Applies	Per DOE-HNDBK-1169, Section 10.6: • The ventilation system filter housing construction materials should be noncombustible. • Process hazards inside and outside the ventilation filter housings should be controlled • General area sprinklers shouldbe provided within all process areas • The final filter housing should be separated from the general building area by firerated construction unless the filter housings have a leading edge surface area of 16 square feet or less, the building has area-wide automatic sprinklers, and the filter housing has an internal fire suppression system • Automatic water spray should be installed upstream of a demister and before the first stage filters • Manual water spray should be installed at the first stage HEPA filter • Fire detection systems should be installed in the final filter housing to allow early warning and activation of the extinguishing system • Automatic flammable gas detection should be provided in filter housings where flammable or combustible processes are performed. • Fire dampers are not allowed in ductwork penetrating fire rated barriers that is part of the nuclear air cleaning system. Such duct penetrations should 1) be made part of the fire rated construction by either wrapping, spraying, or enclosing the duct with an approved material, or 2) be qualified by an engineering analysis for a 2-hour fire-rated exposure to the duct at the penetration location where the duct maintains integrity at the duct penetration with no flame penetration through the fire wallafter a 2-hour fire exposure.	The DSA credits the system to operate during the DBA (fire during drum venting/purging) until the filters become loaded with the fire suppression agent. After which, the flow rate will be insufficient to ensure confinement within the Portable Unit, but the integrity of the HEPA filter and Portable Unit will be maintained. The credible fire event analyzed in the DSA includes two mitigating factors: (1) The quantity of combustible material inside the portable unit enclosure is restricted by requirements in the TSR and the Operating Procedure (Ref. 1). (2) A dry-type fire suppression system is installed in the portable unit enclosure, and will alarm on actuation. This system is identified as a safety support system in the DSA, and is a requirement in the FHA. It is maintained in accordance with the site fire protection program. These mitigating factors will ensure that a fire can not develop of sufficient size and duration to cause the filters to ignite. This control approach of prevention and mitigation will ensure that the system will perform as credited in the DSA. There are no fire detection features or controls for the ventilation system. In the event of a fire, the system will continue to perform its safety function (i.e., to mitigate the consequences of a deflagration or fire in the portable unit) until the filters become loaded with the fire suppression agent. No formal evaluation of the systems response to the DBA has been performed. The intent of the evaluation criteriais satisfied.	DOE-HDBK-1169 (10.1), DOE-STD-1066

Table 5.1 Ventilation System Performance Criteria (cont.)

Evaluation Criteria	Safety Significant	Evaluation Criteria Explained	System Capabilities and Characteristics	Reference
System should not propagate spread of fire	Applies	DOE-HNDBK-1169, Section 10 states: • The accumulation of dust and debris inside the air cleaning system ductwork over long periods of operation provides a mechanism for transporting flames from an ignition source to the filters. (Section 10.5.2.2) • Air cleaning systems should not cross fire area boundaries (Section 10.6.2.2) • Ducts penetrating fire rated barriers should be insulated or enclosed as determined by the FHA (Section 10.6.2.2) • The preferred construction materials for ductwork are steel, stainless steel, or galvanized steel. If fiberglass ductwork is needed, special ductwork meeting the flame-spread criteria in NFPA 90A is required. (Section 10.6.2.2) • Filter casings of wood construction requires a fire retardant treatment that results in a flame spread of 25 or less when tested by ASTM E-84. (Section 10.6.2.2)	The DSA does not credit the system to operate during abnormal or accident conditions, (except during a drum deflagration, as described in section on credible fire events above). The system has very little ductwork (less than 3 feet) upstream the filters to accumulate dust and debris. The duct and filter housings are steel. The system does not have fire dampers or cross any fire area boundaries. The filter casings are constructed of steel. The filter media meets the ASME AG-1 limit for combustible material, (i.e., the combustible material in the filter media shall not exceed 7% by weight when tested as specified in FC-I-4226). The evaluation criteria are satisfied.	DOE-HDBK-1169 (10.1), DOE STD 1066

Table 5.1 Ventilation System Performance Criteria (cont.)

Evaluation Criteria	Safety Significant	Evaluation Criteria Explained	System Capabilities and Characteristics	Reference
System should safely withstand earthquakes	Applies	Per DOE-HNDBK-1169, Section 2.6: • At nuclear facilities, buildings and equipment designated Safety Class or Safety Significant are specifically designed to withstand the effects of a design basis earthquake (DBE). Per DOE-HNDBK-1169, Section 5.6.5: • Instruments used in safety-related systems must be qualified for seismic conditions per ASME AG-1, Section IA. Per DOE-HNDBK-1169, Section 9.2.2: • The DBE for the performance category (PC) of the system should be determined from Table 9.1. External components of the system (e.g. housings, fans, etc.) should be rigidly anchored to major building elements (walls, floors, partitions). The components should perform their intended functions and, if required by procurement specs, should not sustain damage during or after they are subjected to excitations resulting from ground motions due to the DBE. This seismic qualification may be achieved following any one or a combination of analysis, testing, and experience based data.	The system was not designedor credited to operate during or after a DBE. An earthquake occurring during system operation would be an abnormal condition, requiring exit from OPERATION MODE, and possible evacuation per Section 8.9 of the operating procedure (Ref. 2). The intent of the evaluation criteria is satisfied.	DOE-HDBK-1169 (9.2), DOE O420.1B, ASME AG-1 AA

Table 5.1 Ventilation System Performance Criteria (cont.)

Evaluation Criteria	Safety Significant	Evaluation Criteria Explained	System Capabilities and Characteristics	Reference
System should safely withstand tornado depressurization	Applies	Per DOE-HNDBK-1169, Section 5.6.5: • Instruments used in safety-related systems must be qualified for environmental conditions per ASME AG-1, Section IA. Per DOE-HNDBK-1169, Section 9.2.4: • Wind design criteria for a tornado for the performance criteria (PC) of the system should be determined from Table 9.2. Only systems designed based on PC-3 and PC-4 are required to meet the tornado design criteria. Evaluation of existing systems should focus on the strengths of connections and anchorages as well as the ability of the wind loads to find a continuous path to the foundation or support system. All obvious damage sequences should be examined for progressive failures. Once the failure sequences are identified, the system performance is compared with the stated performance goals for the specified PC. See Appendix D of DOE-STD-1020 for more information.	The system was not designed or credited to operate during or after a tornado. A tornado occurring during system operation would be an abnormal condition, requiring exit from OPERATION MODE, and evacuation per Section 8.9 of the operating procedure (Ref. 2). The intent of the evaluation criteria is satisfied.	DOE-HDBK-1169 (9.2), DOE O420.1B

Table 5.1 Ventilation System Performance Criteria (cont.)

Evaluation Criteria	Safety Significant	Evaluation Criteria Explained	System Capabilities and Characteristics	Reference
System should withstand design wind effects on system performance	Applies	Per DOE-HNDBK-1169, Section 5.6.5: • Instruments used in safety-related systems must be qualified for environmental conditions per ASME AG-1, Section IA. Per DOE-HNDBK-1169, Section 9.2.4: • Wind design criteria for a tornado for the performance criteria (PC) of the system should be determined from Table 9.2. Only systems designed based on PC-3 and PC-4 are required to meet the tornado design criteria. Evaluation of existing systems should focus on the strengths of connections and anchorages as well asthe ability of the wind loads to find a continuous path to the foundation or support system. All obvious damage sequences should be examined for progressive failures. Once the failure sequences are identified, the system performance is compared with the stated performance goals for the specified PC. See Appendix D of DOE-STD-1020 for more information.	The system was not designed or credited to operate during a high wind event. A high wind event occurring during system operation would be an abnormal condition, requiring exit from OPERATION MODE, and possible evacuation per Section 8.9 of the operating procedure (Ref. 2). The intent of the evaluation criteria is satisfied.	DOE-HDBK-1169 (9.2), DOE O420.1B
System should withstand other natural phenomenon events considered credible in the DSA where system is credited	Applies	Per DOE-HNDBK-1169, Section 5.6.5: • Instruments used in safety-related systems must be qualified for environmental conditions per ASME AG-1, Section IA. Per DOE-HNDBK-1169, Section 9.2.1: • Evaluate the system based on DOE-STD-1020. The overall DOE National Phenomenon Hazard (NPH) design input, as well as applicable DOE Orders and standards are shown in Figure 9.1.	The system is not credited in the DSA or designed to operate during or after natural phenomenon events. Any natural phenomenon events occurring during system operation would be an abnormal condition, requiring exit from OPERATION MODE, and possible evacuation per Section 8.9 of the operating procedure (Ref. 2). The evaluation criteria are satisfied.	DOE-HDBK-1169 (9.2), DOE O420.1B

Table 5.1 Ventilation System Performance Criteria (cont.)

Evaluation Criteria	Safety Significant	Evaluation Criteria Explained	System Capabilities and Characteristics	Reference
Administrative controls to protect system from barrier-threatening events	Applies	DOE O420.1B Chapter I Section 3.b(2)(f) states: • Systems must include administrative controls to monitor facility conditions during and after an event. DOE O420.1B pg 8 states: • See DOE-STD-1186-2004, Specific Administrative Controls.	Section 5.0 of the TSR lists numerous administrative controls for protection of the work area (and adjacent facilities) from barrier-threatening events, including controls on: • ignition sources • vehicle and fork truck usage • transient combustibles • flammable liquids • hot work • personnel access Additionally: • the adjacent facilities have TSR-credited fire suppression systems • the Portable Units are located less than 1.5 miles from the ORNL Fire Station, which is manned 24/7/365 The evaluation criteria are satisfied.	DOE O420.1B
Design supports periodic inspection and testing of filter houses; tests and inspections are conducted periodically	Applies	Per DOE-HNDBK-1169, Section 2.3.8: • Exhaust system HEPA filter installations must be tested to the requirements of ASME AG-1 Section TA, after each component change. There should be adequate space within and around the filter house to allow for inspection, testing, and maintenance of filters in a safe manner.	In-place efficiency tests are conducted annually and after filter change per ASME N510, as required by the TSR. The minimum efficiency for the in-place test is established in the TSR as 99%. The evaluation criteria are satisfied.	DOE-HDBK-1169 (2.3.8), ASME AG-1, ASME N510

Table 5.1 Ventilation System Performance Criteria (cont.)

Evaluation Criteria	Safety Significant	Evaluation Criteria Explained	System Capabilities and Characteristics	Reference
Instrumentation required to support system operability is calibrated	Applies	Per DOE-HNDBK-1169, Section 5.6.5: • All instruments must be calibrated and tested in accordance with the manufacturer's test procedures.	The filter DP gages are the instrumentation required to support system operability. They are calibrated annually per the manufacturer's instructions as required by the TSR Surveillance Requirements. The evaluation criteria are satisfied.	DOE-HDBK-1169 (2.3.8)
Integrated system performance testing is specified and performed	Applies	Per DOE-HNDBK-1169, Section 2.3.8: • Air cleaning systems designed in accordance with ASME AG-1 should be tested in accordance with ASME AG-1, Section TA. Those systems designed to ASME N509 or still covered by its 2002 maintenance revision, should be tested in accordance with the provisions of ASME N510. Other older systems not designed to either ASME AG-1 or N509 are generally tested by following the guidance in ASME N510.	In-place efficiency tests are conducted annually and after filter change per ASME N510, as required by the TSR. Access to all components of the filter housing, instrumentation, fan, and controls for operation, maintenance, and testing is unencumbered. The accident analysis does not assume any required response for the system. The evaluation criteria are satisfed.	DOE-HDBK-1169 (2.3.8)
Filter service life program should be established	Applies	Per DOE-HNDBK-1169, Appendix C: • Dry filters have a recommended service life of 10 years. Wetted filters have a recommended service life of no more than 5 years. The flow chart used at the Savannah River Site and shown in Appendix C can be used as guidance for system specific service life evaluation.	It is Bechtel Jacob's policy to replace HEPA filters for safety significant systems within 7 years from date of installation, or when the TSR DP limit is reached—whichever occurs first. The current filters were installed in February of 2006, and have never been wetted or exposed to damaging chemicals. Significant radiological loading is not expected; however, the contact dose rate will be monitored periodically, and a replacement based on ALARA considerations would be performed if conditions warrant. The evaluation criteria are satisfied.	DOE-HDBK-1169 (3.1 & App C)
Failure of single component shall not affect operation	Does Not Apply	Per DOE O420.1B, Chapter I, Section 3.b(8): • Safety class electrical systems must be designed to preclude single point failure (No requirements are given for Safety Significant or Defensein-Depth Systems.)	Not applicable.	DOE O420.1B, Chapter I, Sec. 3.b(8)

Table 5.1 Ventilation System Performance Criteria (cont.)

Evaluation Criteria	Safety Significant	Evaluation Criteria Explained	System Capabilities and Characteristics	Reference
Automatic backup electrical power provided to all critical instruments and equipment required to operate and monitor system	Does Not Apply	DOE-HNDBK-1169, Section 2.2.7 states: • Emergency electrical power is required when specified by facility safety documentation. Standby power is required for safetysignificant air cleaning systems. DOE-HNDBK-1169, Section 2.4.2 states: • Where continuous airflow must be maintained, facilities for rapid automatic switching to an alternate power supply are essential. However, if brief interruptions of flow can be tolerated, manual switching may be permissible.	Not applicable.	DOE-HDBK-1169 (2.2.7)
Backup electrical power provided to all critical instruments and equipment required to operate and monitor system	Applies	DOE-HNDBK-1169, Section 2.2.7 states: • Emergency electrical poweris required when specified by facility safety documentation. Standby power is required for safetysignificant air cleaning systems.	The system has no alternate power source. Power failure would be an abnormal condition, requiring exit from OPERATION MODE, and possible evacuation. The system was not designed or credited to operate during an electrical power or component failure. The intent of the evaluation criteria is satisfied.	DOE-HDBK-1169 (2.2.7)
Other specific functional requirements credited in the DSA	Applies		There are no other specific functional requirements credited in the DSA.	10 CFR 830, Subpart B

APPENDIX C

Field Evaluation Team Biographical Sketches

Karen Balo

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Ms. Balo holds a BS Degree in Chemistry and Biology from Texas Woman's University in Denton, Texas. She is a certified member of the Nuclear Facility Safety organization with over 25 years experience in waste management and nuclear facility safety operations.

Patrick Bryan

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Mr. Bryan holds a BS Degree in Mechanical Engineering from State University of New York at Buffalo, and an MS Degree in Engineering Management from the University of Tennessee in Knoxville. He is a licensed Professional Engineer and Certified Energy Manager with over 20 years experience in the design and evaluation of industrial and nuclear ventilation systems and their controls.

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