DOE F 1325.8
(4/93)

United States Government | Department of Energy
Oak Ridge Office

memorandum

DATE: August 1, 2007

REPLY TO
ATTN OF: EM-90:McCracken

SUBJECT: **SUBMITTAL OF CONFINEMENT VENTILATION SYSTEM EVALUATIONS FOR THE DEPARTMENT OF ENERGY OAK RIDGE OFFICE OF ENVIRONMENTAL MANAGEMENT MEDIUM PRIORITY FACILITIES IN RESPONSE TO DEFENSE NUCLEAR SAFETY FACILITIES SAFETY BOARD RECOMMENDATION 2004-2**

TO: Dr. Inés Triay, Chief Operating Officer, Office of Environmental Management, EM-3, FORS

REF: 1) Memorandum for Distribution from Inés R. Triay to Distribution, *Office of Environmental Management Expectations for Implementation of Commitment 8.6 under the Department of Energy Implementation Plan Responding to Defense Nuclear Facilities Safety Board Recommendation 2004-2,* dated June 9, 2006.

2) Letter from Stephen H. McCracken to Michael C. Hughes, *High Efficiency Particulate Air Filters at Oak Ridge National Laboratory,* dated February 23, 2007.

This memorandum provides the Confinement Ventilation System Evaluations for the Oak Ridge Office of Environmental Management (ORO EM) facilities determined to be medium priority in response to the referenced memorandum. Attached are the System Evaluations for the Portable Units (used for installing vents in Transuranic (TRU) waste drums), Low-Level Liquid Waste Facilities (LLLW), and the TRU Waste Processing Center. No gaps relative to the evaluation criteria were identified by the System Evaluation for the TRU Waste Processing Center and LLLW. Three gaps were identified for the Portable Unit. Each of these gaps were determined to not be mandatory based on the Documented Safety Analysis and are adequately addressed by compensatory measures or by the nature of system operations such that the intent of the evaluation criteria functional attribute is satisfied. No upgrades for any of the systems are recommended.

The Site Evaluation Team noted one open issue for the LLLW. The Evaluation Criteria for High Efficiency Particulate Air (HEPA) filter service life ("Filter service life program should be established") is shown as being satisfied based on the responsible contractor's program for HEPA filter management. However, for defense-in-depth and general service HEPA filters, the program does not require change-out of HEPA filters based solely on installed service life. DOE-HNDBK-1196 recommends a service life of 10 years. This issue has been previously identified to Bechtel Jacobs Company LLC in Reference 2 and documented by ORO EM and resolution is in progress.

If you have questions, please call me at (865) 576-0742 or Jay Mullis at (865) 241-3706.

Stephen H. McCracken
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BJC/OR-2867

ACTIVE CONFINEMENT SYSTEM EVALUATION SUMMARY REPORT FOR DNFSB 2004-2

LIQUID LOW-LEVEL WASTE SYSTEM, OAK RIDGE, TENNESSEE

[Subcontractor Name]

contributed to the preparation of this document and should not be considered an eligible contractor for its review.

BJC/OR-2867

ACTIVE CONFINEMENT SYSTEM EVALUATION SUMMARY REPORT FOR DNFSB 2004-2

LIQUID LOW-LEVEL WASTE SYSTEM, OAK RIDGE, TENNESSEE

Date Issued—[July 2007]

Prepared for the
U.S. Department of Energy
Office of Environmental Management

BECHTEL JACOBS COMPANY LLC
managing the
Environmental Management Activities at the
East Tennessee Technology Park
Y-12 National Security Complex   Oak Ridge National Laboratory
under contract DE-AC05-98OR22700
for the
U.S. DEPARTMENT OF ENERGY

APPROVALS

Active Cofinement System Evaluation Summary Report for DNFSB 2004-2

Liquid Low-Level Waste System, Oak Ridge, Tennessee)

[BJC/OR-2867]

[July 31, 2007]

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FIGURES

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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
TRU	Transuranic
WG	Water gage
WOCC	Waste Operations Control Center

1. INTRODUCTION

An initial evaluation of the Liquid Low-Level Waste (LLLW) System was conducted to refine the individual subsytems. The Category 2 facility sets that required evaluation are the three waste tank systems at 2537, 7830, and 7856. This report evaluates only those parts of the LLLW System.

1.1 FACILITY OVERVIEW AND CONFINEMENT SYSTEMS

The LLLW System at Oak Ridge National Laboratory (ORNL) consists of tanks, process equipment, and interconnecting pipelines used for collection, volume reduction, transfer, and storage of LLLW generated at various facilities. The LLLW System is managed by the Bechtel Jacobs Company LLC for the Department of Energy (DOE).

The LLLW System facilities are located at various sites in Bethel Valley and Melton Valley at ORNL. LLLW generated by ORNL facilities is collected at the source facilities, transferred to the LLLW evaporator facility for treatment and volume reduction, and pumped from Bethel Valley through underground pipeline to Melton Valley for storage at Building 7830, the Melton Valley Storage Tanks (MVST), or Building 7856, the Melton Valley Storage Tanks Annex (MVSTA. LLLW generated in the Melton Valley area (e.g., at Buildings 7830 or 7856) may be similarly pumped through the same pipeline to the LLLW evaporator facility for volume reduction and subsequent return for storage at either the MVST or MVSTA facility. A functional block diagram showing the overall LLLW System process flow is provided in Fig.1.

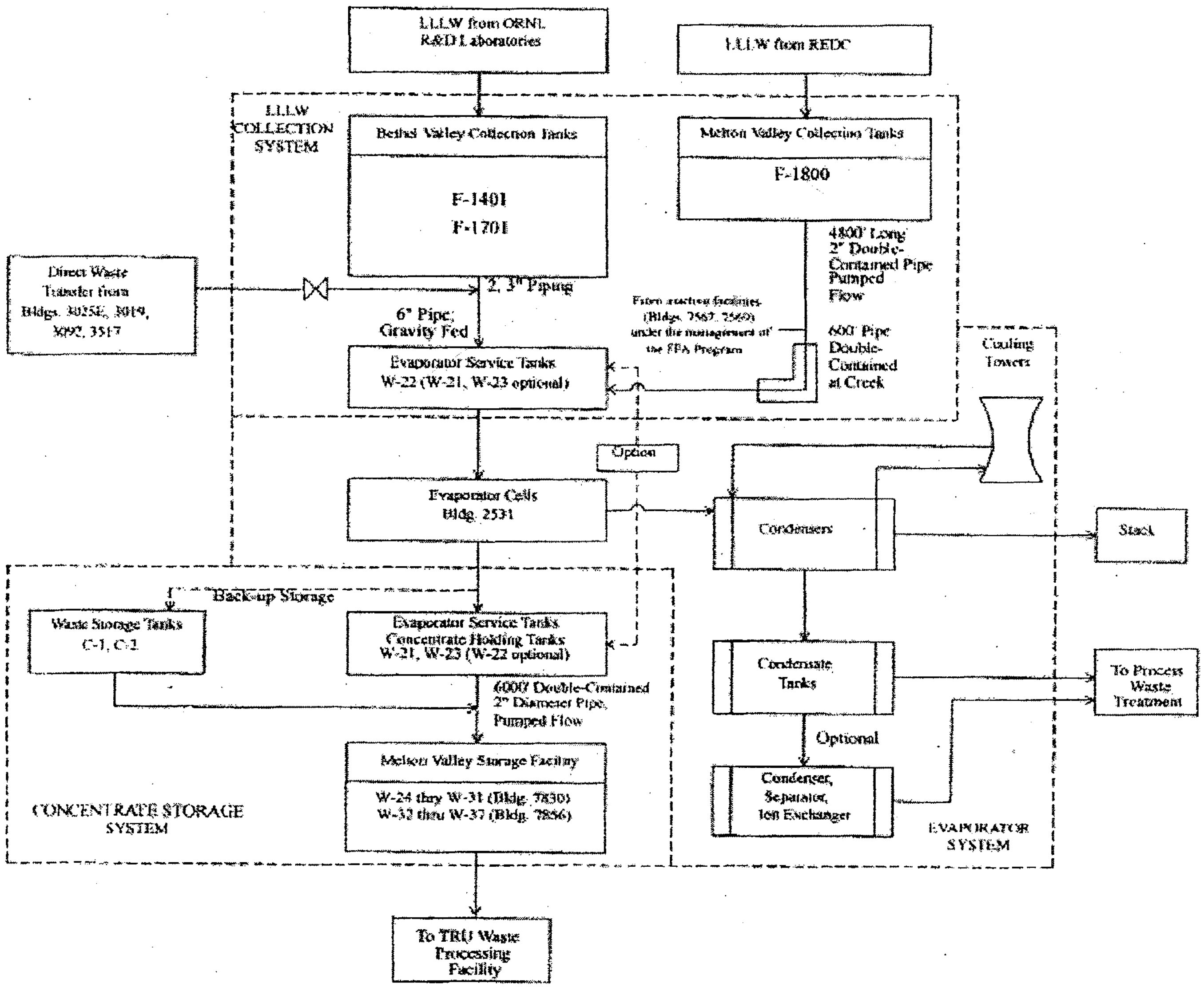

Fig. 1. Block diagram of LLLW system operations

1.1.1 LLLW Evaporator Service Tank Facility

1.1.1.1 Facility overview

Building 2537, located northwest of the Radioactive Waste Evaporator (Building 2531), contains three 50,000-gal underground collection and storage tanks, W-21, W-22, and W-23. These tanks are used to collect and store both dilute and concentrated LLLW. As dilute LLLW is collected from the Bethel Valley and Melton Valley collection systems, it is stored in one of the service tanks. This tank feeds dilute LLLW directly to evaporator 2A2 and indirectly to evaporator A2 via feed tank A1. When the dilute LLLW has been concentrated by the evaporator, the concentrated LLLW is stored in the other two service tanks from where it is periodically transferred to the MVSTA or MVSTs. The service tanks are connected by piping which is arranged so that tank contents and functions may be interchanged. The building contains the service tanks, transfer pumps, piping, and other supporting systems. The building also contains equipment used to mobilize sludges that have accumulated in the tanks and transfer the sludge to the MVSTs at Building 7830.

1.1.1.2 Facility structure

Two of the tanks, W-21 and W-22, are located in a single-reinforced concrete vault. The vault is approximately 31 ft wide by 65 ft, 4-in. long by 16 ft, 2 in. high; the floor elevation is approximately 779 ft, 10 in. above sea level. Tank W-23 is located in a separate vault, approximately 31 ft wide by 65 ft, 4 in. long by 16 ft, 8 in. high; the floor elevation is approximately 788.5 ft. above sea level. The transfer pumps and associated piping are located in a separate reinforced concrete vault, approximately 15 ft wide by 40 ft long, immediately adjacent to and sharing a wall with the W-23 tank vault.

The tanks and vaults are designed for containment of radioactive liquids and provide double containment. The reinforced concrete walls of the tank vaults vary in thickness from 2 ft to 3 ft. The reinforced concrete walls of the pump and valve vault vary in thickness from 1 ft to 3 ft. All vaults are located below-grade. The concrete roof slabs are 3-ft thick and are provided with removable stepped plugs to permit access to the vaults. The pump and valve vault has a metal access hatch on the roof for access. The tank vault floors and walls are lined with 16-gauge stainless steel to a height of approximately 7 ft, 2 in. The pump and valve vault floor and walls are lined with 16-gauge stainless steel up to a height of approximately 3 ft. Sumps and sump pumps are provided in each vault to permit the leakage to return to the service tanks. A section of the evaporator service tanks and vaults is shown in Fig. 2.

1.1.1.3 Confinement systems

Primary confinement of the LLLW in the Evaporator Service Tank facility is provided by the service tanks and their associated piping and equipment. Secondary confinement for the LLLW is provided by stainless-steel-lined concrete vault structures. Additionally, the vaults have sumps that collect and return any leakage to the service tanks. The ventilation system for the evaporator service tanks and vaults is shown in Fig. 3.

Approximately 700 cfm of air is supplied to the vault containing tanks W-21 and W-22 through a roughing filter, a prefilter, and a back-flow preventer. The vault containing tank W-23 receives approximately 350 cfm of supply air from a separate inlet through a roughing filter, a prefilter, and a back-flow preventer. Both of these air streams are discharged through the cell ventilation system filters at Building 2568, to the central ORNL Gaseous Waste Disposal System.

A separate system provides ventilation for the control house. Outside fresh air is drawn in through a roughing filter, a prefilter, and a heating and cooling unit which provides recirculation. A roof exhauster vents this air to the atmosphere through another set of filters consisting of a roughing filter, prefilter, and HEPA filter.

The tank ventilation system has separate air intakes for each tank which draw fresh air through a back-flow preventer, roughing filter, prefilter, and HEPA filter. Each tank exhausts through an individual demister and a common roughing and HEPA filter before discharging through the off-gas system filters at Building 2568 to the central ORNL Gaseous Waste Disposal System.

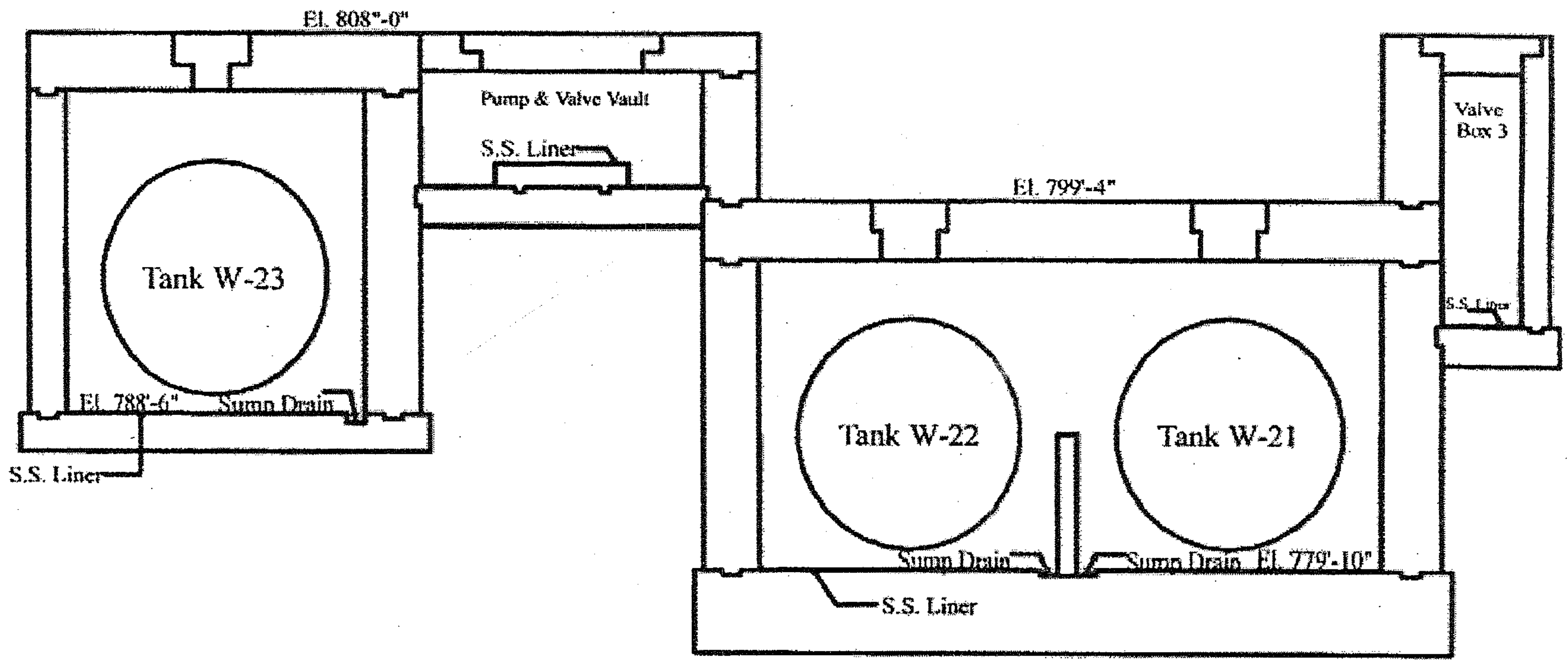

Fig. 2. Evaporator service tanks and vaults

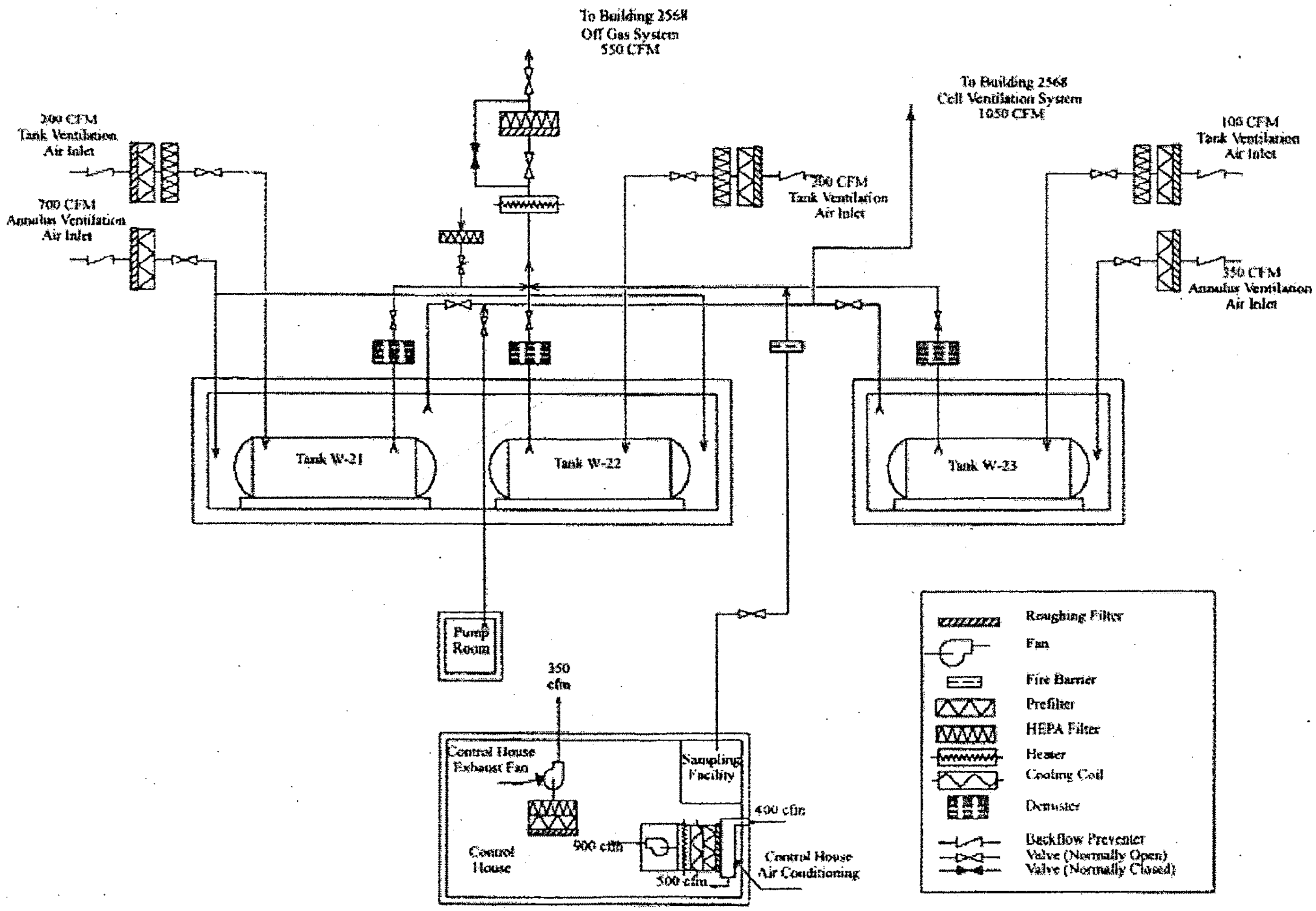

Fig. 3. Building 2537 ventilation

1.1.2 Melton Valley Storage Tank Facility

1.1.2.1 Facility overview

Building 7830, located in Melton Valley near the Liquid Low-Level Waste Solidification Facility (Building 7877), contains eight 50,000-gal storage tanks (installed in two underground vaults) which provide storage capacity for concentrated LLLW from the evaporator. The eight tanks (W-24, W-25, W-26, W-27, W-28, W-29, W-30, and W-31) and their reinforced concrete vaults are designed with containment safeguards for radioactive liquids with the vaults providing secondary confinement.

1.1.2.2 Structure

Four tanks located in each of two identical reinforced-concrete underground vaults (total of eight tanks) are shown in Figs. 4 and 5. Each vault is 67 ft long by 64 ft wide and 19 ft high. The vaults have reinforced concrete walls 2.5-ft to 3-ft thick, floors 3-ft thick, and are covered with 3-ft-thick concrete ceilings. The vaults are lined to a height of 7 ft, 2 in. with 16-gauge stainless steel to contain any tank leakage. Each vault is provided with a 3-ft-square by 1-ft-deep sump to collect leakage. The floor elevation is approximately 762 ft, 9 in. above sea level. The vaults are served by a pump and valve vault (approximately 22 ft wide by 130 ft long and 6 ft, 8 in. high) located below grade immediately south of the vaults. This vault, which contains piping and pumping equipment, is also lined to a height of approximately 3 ft with 16-gauge stainless steel. The floor elevation of the vault is approximately 775 ft. above sea level.

1.1.2.3 Process description

The all-welded horizontal tanks are fabricated of ½ in. stainless steel and measure approximately 61 ft, 5 in. long by 12 ft diameter. These storage tanks are virtually identical to the evaporator service tanks W-21, W-22, and W-23. The tanks operate at atmospheric pressure, but are designed for 15 psig at 150°F and are hydrostatically tested at 22.5 psig.

The storage tanks are equipped with liquid-level indicators, temperature measuring devices, and sampling devices. Instrument readouts are available at the local control house located above grade immediately south of the pipe tunnel and storage tanks. All storage tanks have liquid-level alarms which warn of potential overfilling. A non-specific alarm that indicates abnormal conditions is telemetered to the WOCC in Building 3130. Additionally, the tanks are interconnected to minimize the probability of overfilling.

The local level readout is provided in the Building 7830 control room for the instruments at Building 7830. The liquid level is then transmitted to the WOCC computer system through a local data concentrator by way of a 4 to 20 ma current loop. The signal is converted to a gallons indication at the data concentrator by comparing the analog input to a calibration chart in the concentrator erasable programmable memory before being transmitted to the WOCC main computer for display, trending, and archival.

A 480V electrical disconnect device for each of transfer pumps 4P-1 and 4P-2 is located in the air compressor room at Building 7830.

The primary activities that take place at Building 7830 include:

- Send/receive transfers of LLLW through connections at the Building 7830 valve box.

- Transfer LLLW between tanks at flow rates up to approximately 300 gpm.
- Sludge settling.

The piping is arranged so that liquid can be easily moved to the tank facility site, from one tank to another, or back to the evaporator.

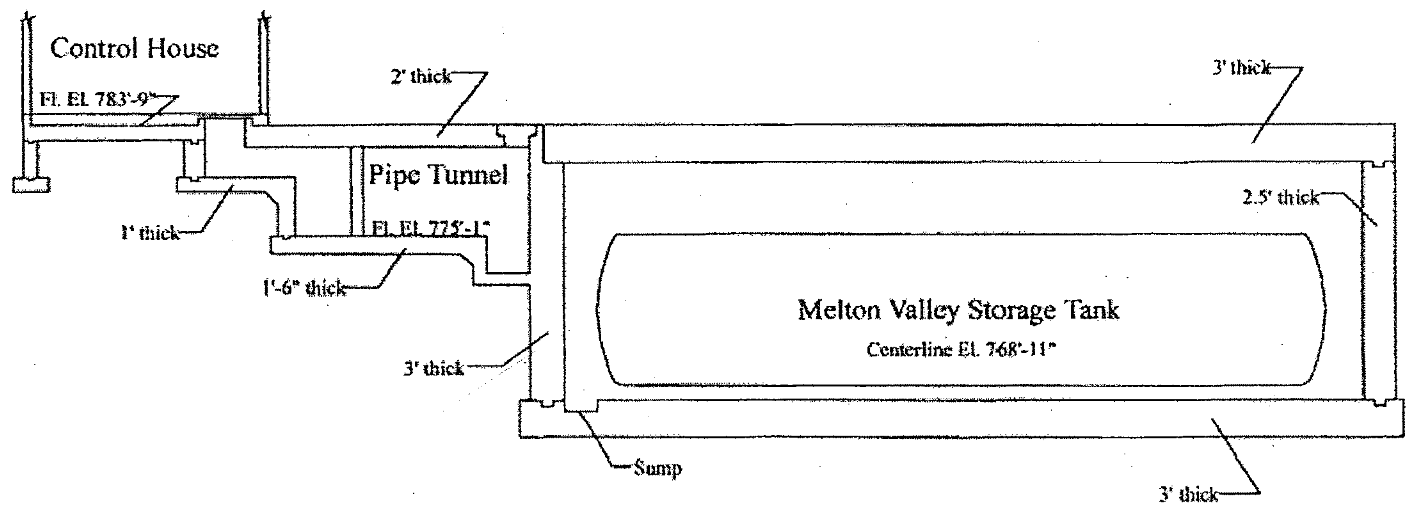

Fig. 4. Melton Valley Storage Tank facility elevation

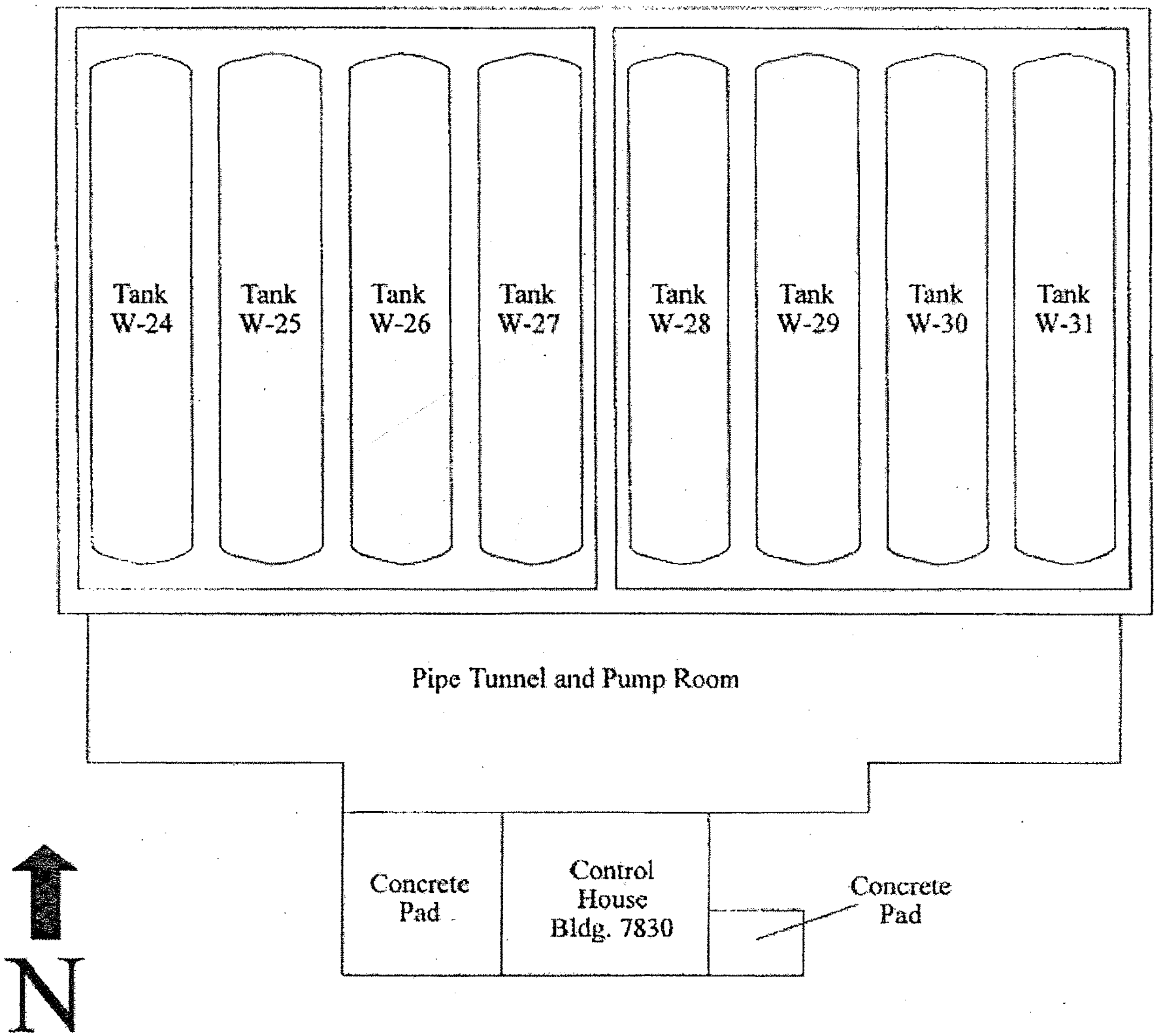

Fig. 5. Melton Valley Storage Tank facility plan

1.1.2.4 Confinement systems

Primary confinement for the LLLW is provided by the storage tanks and the interconnecting pipes, valves, and pumps. Secondary confinement is provided by stainless-steel-lined concrete vaults surrounding the tanks and piping.

Cell and tank off-gas from the MVST Facility cannot be discharged through the central ORNL Gaseous Waste Disposal System because of the facility's remote location. Therefore, following filtration, exhaust is discharged to the atmosphere locally. Separate ventilation systems are provided for the storage tanks, the vaults, the pipe tunnel, and the control house. Two 11 in. diameter, 7 ft tall exhaust stacks sit atop the 10 ft high control house: one for the vault exhaust and one for the tank off-gas exhaust. These systems ensure adequate ventilation to each of the areas and appropriate filtration to prevent release of radioactive particulates from the ventilation exhaust.

Each vault receives approximately 1000 cfm of fresh air through a roughing filter and a pre-filter. This combines with 375 cfm of air from the pipe tunnel, is swept through the cell, and discharges to the atmosphere through a fire barrier, a roughing filter, HEPA filter, and the vault exhaust stack. The pipe tunnel receives 800 cfm of fresh air through a roughing filter and a pre-filter. Of this, 700 cfm joins the cell ventilation through the vaults and the remaining 100 cfm passes through the sampling area and is discharged with the tank off-gas.

Each vault's tank off-gas ventilation system receives 400 cfm of fresh air, which is drawn through a roughing filter, a prefilter, and HEPA filter. This air passes in parallel through the tanks and is discharged to the atmosphere through a demister, a fire barrier, a roughing filter, two HEPA filters, and the tank exhaust stack. Heating, cooling, and fresh air is provided to the 7830 control room by a wall-mounted HVAC unit.

1.1.3 Melton Valley Storage Tanks Annex

1.1.3.1 Facility overview

The purpose of the MVSTA, Building 7856, is to provide long term storage capacity for the liquid low-level radioactive waste system at the ORNL. Currently, wastes generated by operating facilities at ORNL and from remediation activities are transferred to the evaporator service tanks (Buildings 2531 and 2537) for processing in one of two radioactive liquid waste evaporators (Building 2531). The concentrate from the evaporators is then transferred to the MVSTA facility in Melton Valley.

Building 7856 houses six tank vaults with each containing a 100,000-gal horizontal, cylindrical tank. The tanks and tanks vaults are provided with a once-through, HEPA-filtered ventilation system. The walls and floors of the tank vaults are lined with stainless steel to provide secondary confinement in the event of a leak from primary confinement equipment in the vaults. Transfer of liquids out of and between the tanks in Building 7856 is accomplished using one of two 200 gpm Moyno pumps.

The primary processes performed in Building 7856 include transfer of LLLW between the storage tanks and the Intervalley Transfer Pipeline, transfer of LLLW between tanks within Building 7856, sampling, and storage of LLLW.

1.1.3.2 Facility structure

The MVSTA consists of the following facility areas:

- Tank vault area.
- Pump and valve vault area.
- Inlet filter area.
- Exhaust filter and fan area.
- Loading/unloading station.
- Equipment room.
- Control room.
- Sludge mobilization skids.
- Building 7830 valve box and interconnecting pipeline.

The floor plan for Building 7856 including the location of major equipment is shown in Fig. 6. The building code classifications for the different areas in Building 7856 are listed in Tables 1.

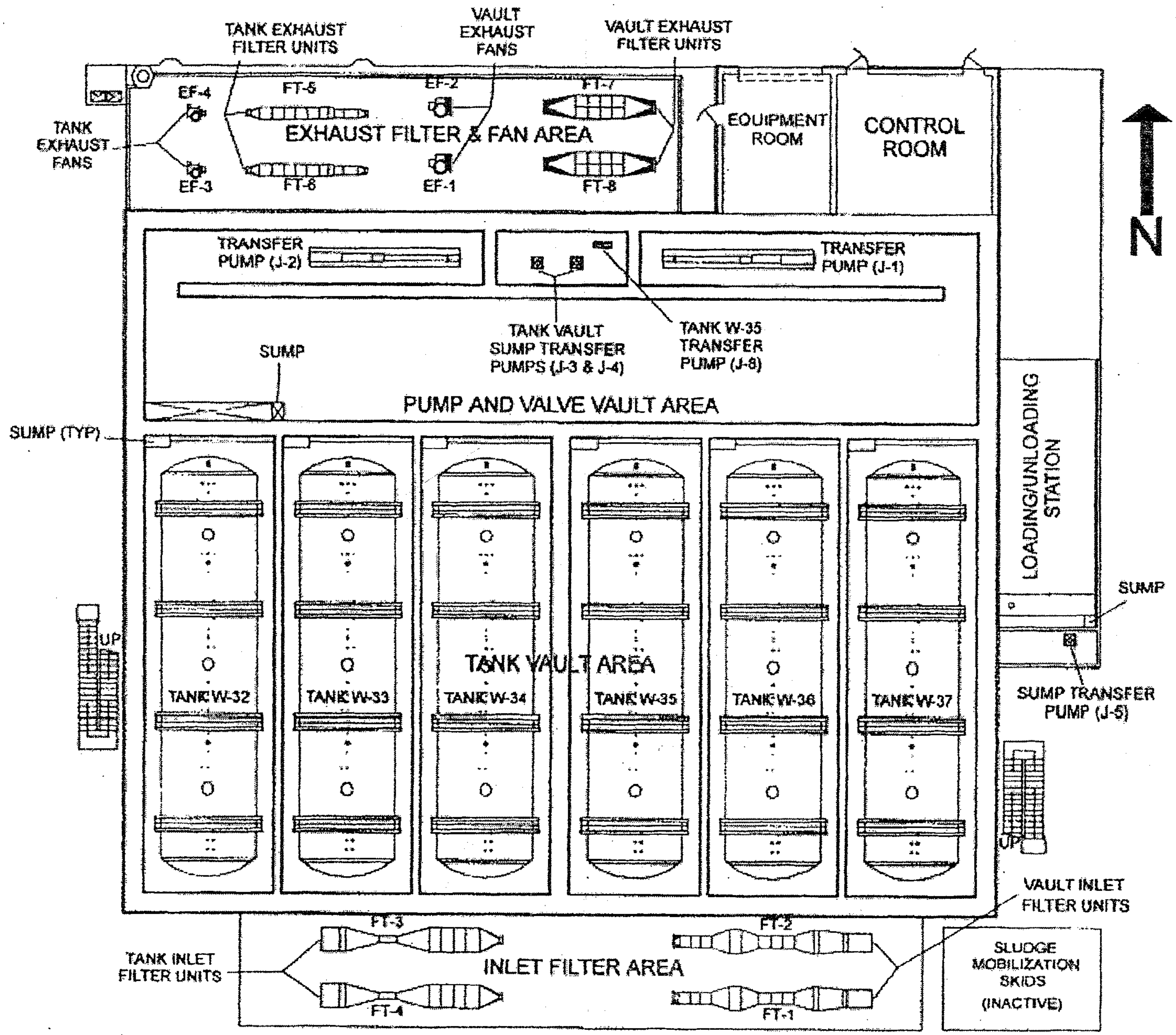

Fig. 6 Building 7856 floor plan and location of major equipment

Table 1. Building 7856 building code classifications

MVSTA feature	BUILDING CODE CLASSIFICATION					
	UCRL-15910	NFPA-101	Uniform Building Code			
	Hazard category	Occupancy classification	Occupancy classification	Type of construction	Seismic occupancy	Seismic zone
Tank vault	Moderate	Confined space, N/A	N/A	II-N	N/A	2A
Pump and valve vault: building structure and liner plate only	Moderate	Confined space, N/A	N/A	II-N	N/A	2A
Equipment room	Important Low	Special purpose Industrial	Group H Division 7	II-N	II	2A
Control room	Moderate*	Special purpose Industrial	Group H Division 7	II-N	II	2A
Fan and outlet filter area	Important Low	N/A	N/A	N/A	II	2A
Inlet filter area	Important	N/A	N/A	N/A	II	2A
Truck transfer station	Important	N/A	Group H Division 7	N/A	II	2A

* Only designed for Low Hazard Natural Phenomena because none of the equipment is required to withstand Moderate Hazard Natural Phenomenon events.

The design loads considered for Building 7856 include the following.

- Moderate hazard structures continuously supported from grade are designed for seismic events having a horizontal acceleration of 0.19g and a vertical acceleration of 0.13g.

- Moderate hazard structures are designed to withstand tornado winds up to 113 mph.

- Moderate hazard structures are designed to withstand the following tornado-generated missiles:
  - 3 in standard steel pipe weighing 75 lbs with a horizontal velocity of 50 mph, a vertical velocity of 35 mph, and a maximum height of 75 ft.
  - 2 x 4 timber plank weighing 15 lbs with a horizontal velocity of 100 mph, a vertical velocity of 70 mph, and a maximum height of 150 ft.

- Tank vault and pump and valve vault are designed to withstand specified vehicle loads.

- Tank vault and pump and valve vault roofs are designed to withstand specified heavy load drops and live loads.

1.1.3.3 Process description

Process operations associated with the MVSTA include the following:

- Transfer operations, including:
  - Transfers into Building 7856 from the Intervalley Transfer Pipeline, Building 7830, or the TRU Waste Processing Facility in Melton Valley;
  - Transfers out of the facility to the Intervalley Transfer Pipeline, Building 7830, or the TRU Waste Processing Facility in Melton Valley; and
  - Transfers between tanks within Building 7856.

- LLLW storage operations, including:
  - Tank level monitoring;
  - Sampling; and
  - Chemical addition.

1.1.3.4 Confinement systems

The LLLW transferred and stored in Building 7856 is within at least two layers of confinement at all times during normal operations. The primary confinement is made up of the six 100,000-gal storage tanks, their ventilation systems, the interconnecting and transfer piping, pumps, and valves. Secondary confinement is provided by the stainless steel liners in the tank vaults, pump and valve vault, and the valve box; by secondary confinement piping in the underground transfer pipeline; and by the vault HVAC systems.

Pressure-relief valves are provided on the outlet piping of the main Moyno© transfer pumps (J-1 and J-2) to prevent overpressure of the piping systems in the event of valve misalignment or malfunction. If the pressure-relief valves are activated, flow is diverted back into the pump inlet piping.

Tank W-32 is normally maintained as spare storage volume where LLLW may be transferred in the event of a leaking tank or other emergency transfer. All of the tanks are equipped with overflow lines at the 90% volume level. The overflow lines flow to a header located in the pump and valve vaults. If the tanks continue to fill to the physical capacity of the tanks, the tanks then overflow via the relief line to the pump and valve vault. The pump and valve vault overflows to the Tank W-32 tank vault and to the Tank W-33 tank vault. The pump and valve vault, Tank W-32 vault, and Tank W-33 vault can hold 100,000 gal, excluding the volume occupied by the W-32 and W-33 tanks.

1.1.3.4.1 Tank, pump, and valve vault sump systems

The tank vaults are lined with stainless steel to a height of 10 ft and slope to a trench located at the north end that drains to a sump in each vault. Redundant sump level instrumentation is provided in each tank vault sump that initiates an alarm in the DCS and on the local alarm enunciator located in the control room (Cabinet KC01).

The pump and valve vault is lined with stainless steel to a height of 1 ft above the highest floor elevation. An overflow line from the pump and valve vault sump flows into the Tank W-32 tank vault sump. Flow is also diverted from this line to the Tank W-33 tank vault sump.

A tank vault sump transfer pump (J4) is located in the pump and valve vault and can pump the tank vault sump contents at 80 gpm (100,000 gal in <24 hr) back into one of the storage tanks or into the pump and valve vault sump. The sump piping system can be valved to transfer pump and valve vault sump contents to one of the storage tanks. The pump and valve vault sump transfer pump (J3) can also transfer to the truck unloading station, if desired.

The pump and valve vault is lined with stainless steel to a height of 1 ft and is sloped such that liquids released within the vault are collected in the pump and valve vault sump. Redundant sump level instrumentation is provided that initiates an alarm in the DCS and on the local alarm annunciator located in the control room (Cabinet KC01). Activation of the alarm terminates transfers out of Building 7856. An excessive release in the pump and valve vault overflows to the Tanks W-32 and W-33 vault sumps. The total volume of the pump and valve vault, the Tank W-32 vault, and the Tank W-33 vault is 100,000 gal, excluding the volume occupied by the tanks. A pump/valve vault sump transfer pump is located in the pump and valve vault that can transfer pump and valve vault contents (at 30 gpm) to the loading/unloading station where a truck connection is provided for transfer of sump contents into a tanker truck.

A sump at the loading/unloading station collects any liquids released during loading and unloading activities. A sump pump (J-5) is provided to transfer sump contents to a tanker truck or to drums. The drain line from the loading/unloading station sump has a manual valve that is closed during sump transfer operations. The manual valve has a position switch with an interlock such that the pump and valve vault sump pump (J3) cannot transfer to the truck unloading station unless the drain valve is closed.

Liquid releases inside the valve box collect in the valve box sump. Redundant sump level instrumentation is provided. A sump transfer pump (J-6) is provided that allows transfer of sump contents to the intervalley transfer line or to a hose connection at the top of the vault. The hose connection can also be used to pump the liquid directly from the sump using an externally supplied pump.

1.1.3.4.2 Heating, ventilation, and air-conditioning systems

Two HVAC systems provide confinement functions for Building 7856: the vault ventilation system and the tank ventilation system.

The vault ventilation system provides once-through ventilation for each of the six tank vaults and for the pump and valve vault. The major equipment and flow paths for the vault ventilation system are shown in Fig. 2.7.1-11. Outside air is drawn into one of two inlet filter units located on the south side of Building 7856 at a rate of 6000 scfm. Inlet air passes through a backflow preventer, a 30% roughing filter, an electric pre-heating coil, a 90% pre-filter, and an electric heating coil. Flow balance is set using a manual damper (HV715 or HV716) to maintain approximately 3.5-in. WG across the filter housing and damper. The ventilation air stream is then split into two headers. One header with 1500 scfm air flow bypasses the tank vaults and flows through eight supply registers into the pump and valve vault. The second header supplies air flow at 750 scfm to each of the six tank vaults. The exhaust ducts from the tank vaults join in a header in the pump and valve vault. Eight exhaust registers in the pump and valve vault also join in a header. The two exhaust headers exit the pump and valve vault and join in the exhaust filter and fan area located on the north side of Building 7856. The total air flow is then directed to one of two exhaust filter units where it passes through a 90% prefilter and a HEPA filter. Air flow exiting the exhaust filter unit is directed to one of two exhaust fans and then to the elevated facility exhaust stack. Flow balance at the exhaust filter unit is set using a manual damper (HV719 or HV720) to maintain approximately 5.0-in. WG across the filter housing and damper.

The tank ventilation system provides once-through ventilation for the six 100,000-gal storage tanks located in Building 7856. Outside air is drawn in at a rate of 900 scfm through one of two inlet filter units located on the south side of Building 7856. Air passes through a 30% roughing filter, an electric heating coil, a 60% pre-filter, and a HEPA filter (with its inlet and outlet test sections). Flow balance is set by a manual damper (HV713 or HV714) to maintain 4.5-in. WG across the filter housing and damper. The air flows into a tank inlet header that provides 150 scfm to each of the six tanks. Flow through the tanks is monitored by flow elements in the ventilation exhaust from each tank. In addition, a combustible gas monitor is provided on the exhaust from each tank. The exhaust ducts from each tank join in a header in the pump and valve vault. The air in the exhaust header is directed to one of two exhaust filter units located on the north side of Building 7856. The exhaust filter unit includes an electric heating coil, a 60% pre-filter, and two HEPA filters (with appropriate test sections). Air flow is then drawn through one of two exhaust fans and exits the facility through the elevated facility stack downstream of the vault ventilation exhaust duct work. Flow balance at the exhaust filter unit is set using a manual damper (HV717 or HV718) to maintain 6.0-in. WG across the filter housing and damper.

Each of the six storage tanks is equipped with a relief line. The relief lines from the tanks meet in a common header located in the pump and valve vault. One line from the header has a water seal in a pipe trap. If liquid overflows from the tanks through the relief line, it will drain directly through this line to the pump and valve vault sump. A separate line from the header is equipped with a rupture disk set at 11.4 psig. In the event of HVAC failures such that the tank ventilation system is pressurized, this line opens to the pump and valve vault.

1.2 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

Each of the three facilities confinement ventilation systems are currently classified as a defense in depth system 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*. It was determined that because the tank systems are Category 2 facilities that are actively filtered and ventilated an evaluation should be performed to confirm the defense in depth status of the ventilation 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. The HEPA filter systems are identified in the DSA as a DID control that is not credited for significantly reducing event consequences. The ventilation systems are not individually credited for reducing event consequences to a lower risk bin. Specific performance criteria include maintaining dp across the HEPA filters and are maintained per the surveillance and maintenance program. Functional criteria, performance criteria, or quantitative filtering efficiency criteria are not defined 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 secondary containment systems such as the vaults in lieu of the ventilation systems.

2.3 SUMMARY

The FET concluded that the HEPA filtered ventilation systems associated with the LLLW System are appropriately and conservatively classified as defense in depth.

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 tank ventilation systems were evaluated against the defense-in-depth criteria defined in the evaluation guidance document. No gaps were identified.

3.2 GAP EVALUATION

3.3 MODIFICATIONS AND UPGRADES

No gaps were identified, therefore, no modifications are recommended at this time.

4. CONCLUSION

In conclusion, the HEPA Filter Systems on the tank systems at 2537, 7830, and 7856 are appropriately classified in the DSA as defense in depth.

APPENDIX A

Table 4-3 Data Collection Table

Confinement Documented Safety Analysis Information										
Facility: LLLW – Bldg. 2537			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				
Spills/Leaks (Event 2537-17)	X		Unmitigated Public - <1rem Collocated - <100 but >25 rem Mitigated Public - <1 rem Collocated - <25 rem			X	B – Confinement for collocated worker protection	Reduces consequence of a spill inside a tank, pump, or valve vault.	Initial design and construction in general accordance with Code of Record (e.g., Uniform Building Code (UBC)) for general use or low hazard facilities in effect at the time of construction. Time of construction spans several decades depending on the facility and/or component. Current performance criteria in accordance with general Safety Management Program (SMP) requirements for general use ventilation systems.	None
Fires (Event 2537-12)	X		Unmitigated Public - <1 rem Collocated - <25 rem Mitigated – no mitigation evaluated			X	C – Exhaust of explosive mixtures	Prevents the accumulation of combustible gas/vapors, reducing the probability of a fire in a tank vapor space.	Initial design and construction in general accordance with Code of Record (e.g., UBC) for general use or low hazard facilities in effect at the time of construction. Time of construction spans several decades depending on the facility and/or component. Current performance criteria in accordance with general SMP requirements for general use ventilation systems.	None

Table 4-3 Data Collection Table Explanations for Building 2537

Facility Overview. Building 2537, located northwest of the Radioactive Waste Evaporator (Building 2531), contains three 50,000-gal underground collection and storage tanks, W-21, W-22, and W-23. These tanks are used to collect and store both dilute and concentrated Liquid Low-Level Waste (LLLW). As dilute LLLW is collected from the Bethel Valley and Melton Valley collection systems, it is stored in one of the service tanks. This tank feeds dilute LLLW directly to evaporator 2A2 and indirectly to evaporator A2 via feed tank A1. When the dilute LLLW has been concentrated by the evaporator, the concentrated LLLW is stored in the other two service tanks from where it is periodically transferred to tanks located at Buildings 7830 and 7856. The service tanks are connected by piping which is arranged so that tank contents and functions may be interchanged. The building contains the service tanks, transfer pumps, piping, and other supporting systems. The building also contains equipment used to mobilize sludges that have accumulated in the tanks and transfer the sludge to the Melton Valley Storage Tanks at Building 7830. Transfer of LLLW to Buildings 7830 and 7856 uses the Intervalley Transfer Pipeline (a 6,000+ long double-contained pipeline with associated valve boxes that provides connections between Buildings 2537, 7830, and 7856).

Column 1 – Bounding Accidents

Spill/Leaks (event 2537-17)

The LLLW System consists primarily of a number of tanks and pumps in ventilated vaults at various facilities. LLLW can be pumped from tanks at one facility to the tanks at another through long lengths of transfer pipelines that are not in ventilated enclosures. The bounding spill/leak event involves a pressurized release of LLLW during specific and infrequent (i.e., less than once a year) transfers due to a component failure or operator errors. The release could be inside a vault that has high-efficiency particulate air (HEPA) filtered ventilation or along the length of transfer pipeline directly to the environment. The unmitigated hazard evaluation (UHE) for the LLLW System evaluated spills/leaks that could occur in these systems due to various causes and listed candidate controls that might be available to reduce the risk of the event. The vault ventilation systems and HEPA filters were identified as candidate controls for those events where the LLLW could be released into an intact vault. The vault ventilation systems and HEPA filters were not identified as candidate controls for events that are initiated by or involve a breech of the vault (e.g., vault collapse due to external impact).

The UHE assumed all material made airborne would be released directly to the environment with no credit for any holdup or filtration (i.e., all leakpath factors were assumed to be 1.0). Events with significant consequences to any receptor were carried forward and evaluated in the mitigated hazard evaluate (MHE) to determine which candidate controls would be credited to reduce the risk of the event. Only pressurized releases of LLLW during pumping were identified as having the potential for significant consequences to any receptor (collocated worker only). All non-pressurized releases are of such low consequence to all receptors that identification of controls to reduce risk was not considered necessary and they were screened from further evaluation.

During selection of controls in the MHE, it was determined that the only candidate controls that would be effective in reducing the risk of spills/leaks in any location along the transfer pathway were (1) the work control process to reduce the frequency of operator errors, and (2) equipment to identify a spill/leak had occurred and allow for immediate termination of the transfer. Immediately terminating the transfer prevents the release of a significant quantity of LLLW whether the release occurs inside or outside a vault and whether the vault is intact or not intact.

Fires (event 2537-12)

The bounding fire event involves the ignition of hydrogen or contaminated organic materials in the vapor space of one of the large LLLW storage tanks. The LLLW is contained within the steel tanks in concrete vaults containing little or no combustible materials or in buried steel pipelines. Therefore, no other fires of any significance were identified. The UHE for the LLLW System evaluated fires that could occur due to various causes and listed candidate controls that might be available to reduce the risk of the event. The tank ventilation systems were identified as candidate controls that could act to prevent accumulation of combustible vapors in the tank vapor space. However, all fire events are of such low consequence to all receptors that identification of credited controls to reduce the risk was not considered necessary and they were screened from further evaluation.

Column 2 – Type Confinement

The vault and tank ventilation system for Bldg. 2537 is an active HEPA filtered exhaust system, although the active portions are not part of the LLLW System, but provided by a central ventilation system. The HEPA filters are located at Bldg. 2568, which is part of the LLLW System. The filtered exhaust is discharged by fans in the Building 3039 Stack Ventilation System through the Building 3039 Stack. The 3039 Stack Ventilation System (including ducts, fans, and stack) is a separate, non-nuclear facility that provides general ventilation services to customers located throughout the main Oak Ridge National Laboratory (ORNL) campus in Bethel Valley.

Column 3 – Doses (Bounding Unmitigated and Mitigated)

Methodology

Potential radiological consequences from inhalation were determined (LLLW Documented Safety Analysis (DSA), Section 3.3.2.4.1)) by using 95^{th} percentile relative concentrations (X/Q values) calculated consistent with Nuclear Regulatory Commission (NRC) Regulatory Guide 1.145 as recommended by DOE-STD-3009-94, Appendix A. Releases were modeled using straight-line Gaussian dispersion characteristics. All releases were assumed to be at ground level and to exhibit normal buoyancy. The calculation of the 95^{th} percentile X/Q for each location is documented in DAC-LGWO-2002-001.

The inhalation dose from radioactive materials is determined by calculating the integral of air concentration for the time during which the receptor is exposed, multiplying by the breathing rate of the individual, and then multiplying by the dose conversion factor for the radioactive material of interest. The following equations were used:

$$I = Q * X/Q$$

where: I = time integral of air concentration (Ci-sec/m_3)
Q = the activity released to the air (Ci)
X/Q = location-specific relative concentration (sec/m_3)

$$Q = dQ/dt * t$$

where: t = lesser of the duration of the release and the receptor exposure time(s)

$$dQ/dt = RR * C * RRF$$

where: RRF = ARF x RF (from DOE HDBK-3010-94)
ARF = airborne release fraction
RF = respirable fraction
RR = liquid release rate (L/s)
C = liquid concentration (Ci/L)
RRF = respirable release fraction

$$D = I * B_r * DCF$$

where: D = dose (rem)
B_r = breathing rate (m^3/s)
DCF = dose conversion factor (rem/Ci)

The following assumptions are applied to the calculation of inhalation dose:

- The off-site receptor exposure time is 2 hours.
- The on-site receptor exposure time is 8 hours.
- Releases are at ground level (yields higher consequences than elevated releases).
- Receptor breathing rates are 1.2 m^3/h.
- Bounding ARFs and RFs from DOE HDBK-3010-94 are selected for the type of accident and material involved.

The calculation of unmitigated dose due to each evaluated accident is documented in DAC- LGWO-2002-002. Mitigated doses were evaluated qualitatively given the unmitigated dose and the estimated effectiveness of the credited controls.

<u>**Spill/leak (event 2537-17)**</u>

The areas into which release may occur are not occupied. Any facility workers that may be near the facility are assumed to evacuate and were evaluated as collocated workers. The unmitigated estimate of the radiological consequences to the collocated worker was estimated to be between 25 rem and 100 rem. The unmitigated estimate of the radiological consequences to the public was estimated to be <1 rem. The mitigated dose to the collocated worker is estimated to be <25 rem due to operator action to terminate the transfer. No estimate of the mitigated dose to the public was required or made in the DSA, but would remain < 1 rem.

<u>**Fires (event 2537-12)**</u>

The areas into which release may occur are not occupied. Any facility workers that may be near the facility are assumed to evacuate and were evaluated as collocated workers. The unmitigated estimate of the radiological consequences to the collocated worker was estimated to be < 25 rem. The unmitigated estimate of the radiological consequences to the public was estimated to be <1 rem. No estimate of the mitigated dose to the collocated worker or public was required or made in the DSA.

Column 4 – Confinement Classification

The tank and vault ventilation system (portions within the LLLW System boundary) is classified as a defense-in-depth feature in the LLLW System DSA. It is noted that the active portions of the system are not within the LLLW System boundary.

Column 5 – Function

Spill/leak (event 2537-17)

The vault ventilation system reduces consequence of a release of LLLW inside an intact tank, pump, or valve vault that results in an inhalation hazard to collocated workers.

Fires (event 2537-12)

The tank ventilation system prevents the accumulation of combustible vapors/gases that could result in a fire in a tank vapor space. A fire in the tank vapor space is of such low consequences that this function is considered to be limited to contamination control rather than any significant reduction in consequences to on-site or off-site receptors.

Column 6 – Functional Requirements

Spill/leak (event 2537-17)

Because the vault ventilation systems are non-credited defense-in-depth, no specific functional requirements were defined in the DSA and none are implied by the UHE. It is expected that the vault ventilation system and HEPA filters, if available, could act to reduce the consequence of a release of LLLW inside an intact tank, pump, or valve vault that results in an inhalation hazard to collocated workers.

Fires (2537-12)

Because the tank ventilation systems are non-credited defense-in-depth, no specific functional requirements were defined in the DSA and none are implied by the UHE. It is expected that the airflow provided through the tanks by the tank ventilation system, if available, could act to reduce the probability of a fire in the tank vapor space.

Column 7 – Performance Criteria

The various elements of the ventilation system were designed and constructed over a time period that spans several decades. Initial design and construction for each element was in general accordance with the Code of Record (e.g., UBC) for general use or low hazard facilities in effect at the time of construction. Because many portions of the system were intended for general use only and are known to have limited capability to remain intact under accident conditions (e.g., 3039 Stack), the ventilation system is not expected or known to be capable of performing its function other than during normal operations. Therefore, current performance criteria are in accordance with the general Safety Management Program (SMP) requirements for general use ventilation systems.

The ventilation system is operated in accordance with the general performance criteria established in the Safety Management Programs, which establish requirements for operations in accordance with approved procedures and periodic inspections and testing. The system is operated in accordance with the facility operating procedures (WM-LGWO-611.3.1), which establish the maximum differential pressure across the filters as well as the requirements to maintain the vessels at a higher negative pressure than their vaults, and for the vaults to be maintained negative relative to atmosphere.

The filters are subject to a percentage of the filters used being 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 dioctyl phthalate (DOP) 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.

Column 8 – Compensatory Measures

No vulnerabilities have been identified that would impact the ventilation system's ability to meet the above performance criteria. Therefore, no compensatory measures are identified.

Table 4-3 Data Collection Table

Confinement Documented Safety Analysis Information										
Facility: LLLW – Bldg. 7830			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				
Spill/leak (Event 7830-18)	X		Unmitigated Public - <1rem Collocated - <100 but >25 rem Mitigated Public - <1 rem Collocated - <25 rem			X	B – Confinement for collocated worker protection	Reduces consequence of a spill inside a tank, pump, or valve vault.	Initial design and construction in general accordance with Code of Record (e.g., Uniform Building Code (UBC)) for general use or low hazard facilities in effect at the time of construction. Current performance criteria in accordance with general Safety Management Program (SMP) requirements for general use ventilation systems.	None
Fire (Event 7830-13)	X		Unmitigated Public - <1 rem Collocated - <25 rem Mitigated – no mitigation evaluated			X	C – Exhaust of explosive mixtures	Prevents the accumulation of combustible gas/vapors, reducing the probability of a fire in a tank vapor space.	Initial design and construction in general accordance with Code of Record (e.g., UBC) for general use or low hazard facilities in effect at the time of construction. Current performance criteria in accordance with general SMP requirements for general use ventilation systems.	None

Table 4-3 Data Collection Table Explanations for Building 7830

Facility Overview. Building 7830, located in Melton Valley near the Liquid Low-Level Waste (LLLW) Solidification Facility (Building 7877), contains eight 50,000-gal storage tanks (installed in two underground vaults with four tanks per vault) which provide storage capacity for concentrated LLLW from the evaporator facility in Bethel Valley. The eight tanks (W-24, W-25, W-26, W-27, W-28, W-29, W-30, and W-31) and their reinforced concrete vaults are designed with containment safeguards for radioactive liquids with the vaults providing secondary confinement. The building also contains the transfer pumps, piping, and other supporting systems.

The primary processes performed in Building 7830 include transfer of LLLW between the storage tanks and the Intervalley Transfer Pipeline (a 6,000+ long double-contained pipeline with associated valve boxes that provides connections between Buildings 2537, 7830, and 7856), transfer of LLLW between tanks within Building 7830, and storage of LLLW.

Column 1 – Bounding Accidents

Pressurized releases (event 7830-18)

The LLLW System consists primarily of a number of tanks and pumps in ventilated vaults at various facilities. LLLW can be pumped from tanks at one facility to the tanks at another through long lengths of transfer pipelines that are not in ventilated enclosures. The bounding spill/leak event involves a pressurized release of LLLW during specific and infrequent (i.e., less than once a year) transfers due to a component failure or operator errors. The release could be inside a vault that has high-efficiency particulate air (HEPA) filtered ventilation or along the length of transfer pipeline directly to the environment. The unmitigated hazard evaluation (UHE) for the LLLW System evaluated spills/leaks that could occur in these systems due to various causes and listed candidate controls that might be available to reduce the risk of the event. The vault ventilation systems and HEPA filters were identified as candidate controls for those events where the LLLW could be released into an intact vault. The vault ventilation systems and HEPA filters were not identified as candidate controls for events that are initiated by or involve a breech of the vault (e.g., vault collapse due to external impact).

The UHE assumed all material made airborne would be released directly to the environment with no credit for any holdup or filtration (i.e., all leakpath factors were assumed to be 1.0). Events with significant consequences to any receptor were carried forward and evaluated in the mitigated hazard evaluate (MHE) to determine which candidate controls would be credited to reduce the risk of the event. Only pressurized releases of LLLW during pumping were identified as having the potential for significant consequences to any receptor (collocated worker only). All non-pressurized releases are of such low consequence to all receptors that identification of controls to reduce risk was not considered necessary and they were screened from further evaluation.

During selection of controls in the MHE, it was determined that the only candidate controls that would be effective in reducing the risk of spills/leaks in any location along the transfer pathway were (1) the work control process to reduce the frequency of operator errors, and (2) equipment to identify a spill/leak had occurred and allow for immediate termination of the transfer. Immediately terminating the transfer prevents the release of a significant quantity of

LLLW whether the release occurs inside or outside a vault and whether the vault is intact or not intact.

Fires (event 7830-13)

The bounding fire event involves the ignition of hydrogen or contaminated organic materials in the vapor space of one of the large LLLW storage tanks. The LLLW is contained within the steel tanks in concrete vaults containing little or no combustible materials or in buried steel pipelines. Therefore, no other fires of any significance were identified. The UHE for the LLLW System evaluated fires that could occur due to various causes and listed candidate controls that might be available to reduce the risk of the event. The tank ventilation systems were identified as candidate controls that could act to prevent accumulation of combustible vapors in the tank vapor space. However, all fire events are of such low consequence to all receptors that identification of credited controls to reduce the risk was not considered necessary and they were screened from further evaluation.

Column 2 – Type Confinement

The ventilation system for Bldg. 7830 is an active HEPA filtered exhaust system. Following filtration, exhaust is discharged to the atmosphere locally. Separate ventilation systems are provided for the storage tanks, the vaults, the pipe tunnel, and the control house. Two 11-in.-diameter, 7-ft-tall exhaust stacks are located at the facility: one for the vault exhaust and one for the tank off-gas exhaust.

Column 3 – Doses (Bounding Unmitigated and Mitigated)

Methodology

Potential radiological consequences from inhalation were determined (LLLW Documented Safety Analysis (DSA), Section 3.3.2.4.1)) by using 95th percentile relative concentrations (X/Q values) calculated consistent with Nuclear Regulatory Commission (NRC) Regulatory Guide 1.145 as recommended by DOE-STD-3009-94, Appendix A. Releases were modeled using straight-line Gaussian dispersion characteristics. All releases were assumed to be at ground level and to exhibit normal buoyancy. The calculation of the 95th percentile X/Q for each location is documented in DAC-LGWO-2002-001.

The inhalation dose from radioactive materials is determined by calculating the integral of air concentration for the time during which the receptor is exposed, multiplying by the breathing rate of the individual, and then multiplying by the dose conversion factor for the radioactive material of interest. The following equations were used:

$$I = Q * X/Q$$

where: I = time integral of air concentration (Ci-sec/m^3)
Q = the activity released to the air (Ci)
X/Q = location-specific relative concentration (sec/m^3)

$$Q = dQ/dt * t$$

where: t = lesser of the duration of the release and the receptor exposure time(s)

$$dQ/dt = RR * C * RRF$$

where: RRF = ARF x RF (from DOE HDBK-3010-94)
ARF = airborne release fraction
RF = respirable fraction
RR = liquid release rate (L/s)
C = liquid concentration (Ci/L)
RRF = respirable release fraction

$$D = I * B_r * DCF$$

where: D = dose (rem)
B_r = breathing rate (m^3/s)
DCF = dose conversion factor (rem/Ci)

The following assumptions are applied to the calculation of inhalation dose:

- The off-site receptor exposure time is 2 hours.
- The on-site receptor exposure time is 8 hours.
- Releases are at ground level (yields higher consequences than elevated releases).
- Receptor breathing rates are 1.2 m^3/h.
- Bounding ARFs and RFs from DOE HDBK-3010-94 are selected for the type of accident and material involved.

The calculation of unmitigated dose due to each evaluated accident is documented in DAC- LGWO-2002-002. Mitigated doses were evaluated qualitatively given the unmitigated dose and the estimated effectiveness of the credited controls.

<u>Spill/leak (event 7830-18)</u>

The areas into which release may occur are not occupied. Any facility workers that may be near the facility are assumed to evacuate and were evaluated as collocated workers. The unmitigated estimate of the radiological consequences to the collocated worker was estimated to be between 25 rem and 100 rem. The unmitigated estimate of the radiological consequences to the public was estimated to be <1 rem . The mitigated dose to the collocated worker is estimated to be <25 rem due to operator action to terminate the transfer. No estimate of the mitigated dose to the public was required or made in the DSA, but would remain < 1 rem.

<u>Fires (event 7830-13)</u>

The areas into which release may occur are not occupied. Any facility workers that may be near the facility are assumed to evacuate and were evaluated as collocated workers. The unmitigated estimate of the radiological consequences to the collocated worker was estimated to be < 25 rem. The unmitigated estimate of the radiological consequences to the public was estimated to be <1 rem. No estimate of the mitigated dose to the collocated worker or public was required or made in the DSA.

Column 4 – Confinement Classification

The tank, vault, and pipe tunnel ventilation systems are classified as non-credited defense-in-depth features in the LLLW System DSA. The control house ventilation is not identified as a candidate control or defense-in-depth system in the DSA.

Column 5 - Function

__Spill/leak (event 7830-18)__

The vault and pipe tunnel ventilation systems reduce the consequence of a release of LLLW inside an intact tank, pump, valve vault, or pipe tunnel that results in an inhalation hazard to collocated workers.

__Fires (event 7830-13)__

The tank ventilation system prevents the accumulation of combustible vapors/gases that could result in a fire in a tank vapor space. A fire in the tank vapor space is of such low consequences that this function is considered to be limited to contamination control rather than any significant reduction in consequences to on-site or off-site receptors.

Column 6 – Functional Requirements

__Spill/leak (event 7830-18)__

Because the vault and pipe tunnel ventilation systems are non-credited defense-in-depth, no specific functional requirements were defined in the DSA and none are implied by the UHE. It is expected that the ventilation systems and HEPA filters, if available, could act to reduce the consequence of a release of LLLW inside an intact tank, pump, valve vault, or pipe tunnel that results in an inhalation hazard to collocated workers.

__Fires (7830-13)__

Because the tank ventilation systems are non-credited defense-in-depth, no specific functional requirements were defined in the DSA and none are implied by the UHE. It is expected that the airflow provided through the tanks by the tank ventilation system, if available, could act to reduce the probability of a fire in the tank vapor space.

Column 7 – Performance Criteria

Initial design and construction for each element was in general accordance with the Code of Record (e.g., UBC) for general use or low hazard facilities in effect at the time of construction. Because portions of the system were intended for general use only, the ventilation system is not expected or known to be capable of performing its function other than during normal operations. Therefore, current performance criteria are in accordance with the general Safety Management Program (SMP) requirements for general use ventilation systems.

The ventilation system is operated in accordance with the general performance criteria established in the Safety Management Programs, which establish requirements for operations in accordance with approved procedures and periodic inspections and testing. The system is operated in accordance with the facility operating procedures (WM-LGWO-610.3.1), which establish the maximum differential pressure across the filters as well as the requirements to maintain the vessels at a higher negative pressure than their vaults, and for the vaults to be maintained negative relative to atmosphere.

The filters are subject to a percentage of the filters used being 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 dioctyl phthalate (DOP) 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.

Column 8 – Compensatory Measures

No vulnerabilities have been identified that would impact the ventilation system's ability to meet the above performance criteria. Therefore, no compensatory measures are identified.

Table 4-3 Data Collection Table

Confinement Documented Safety Analysis Information										
Facility: LLLW – Bldg. 7856			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				
Spills/leaks (Event 7856-18)	X		Unmitigated Public - <1rem Collocated - <100 but >25 rem Mitigated Public - <1 rem Collocated - <25 rem			X	B – Confinement for collocated worker protection	Reduces consequence of a spill inside a tank, pump, or valve vault.	Initial design and construction in general accordance with Code of Record (e.g., Uniform Building Code (UBC)) for general use or low hazard facilities in effect at the time of construction. Current performance criteria in accordance with general Safety Management Program (SMP) requirements for general use ventilation systems.	None
Fires (Event 7856-13)	X		Unmitigated Public - <1 rem Collocated - <25 rem Mitigated – no mitigation evaluated			X	C – Exhaust of explosive mixtures	Prevents the accumulation of combustible gas/vapors, reducing the probability of a fire in a tank vapor space.	Initial design and construction in general accordance with Code of Record (e.g., UBC) for general use or low hazard facilities in effect at the time of construction. Current performance criteria in accordance with general SMP requirements for general use ventilation systems.	None

Table 4-3 Data Collection Table Explanations for Building 7856

Facility Overview. The purpose of the Melton Valley Storage Tanks Annex (Building 7856), is to provide long term storage capacity for the liquid low-level radioactive waste system at the ORNL. Currently, wastes generated by operating facilities at ORNL and from remediation activities are transferred to the evaporator service tanks (Buildings 2531 and 2537) for processing in one of two radioactive liquid waste evaporators (Building 2531). The concentrate from the evaporators is then transferred to either Building 7830 or 7856 located in Melton Valley. Building 7856 houses six tank vaults with each containing a 100,000-gal horizontal, cylindrical tank (W-32, W-33, W-34, W-35, W-36, and W-37). The tanks and tanks vaults are provided with a once-through, HEPA-filtered ventilation system. The walls and floors of the tank vaults are lined with stainless steel to provide secondary confinement in the event of a leak from primary confinement equipment in the vaults. Transfer of liquids out of and between the tanks in Building 7856 is accomplished using pumps located at the facility.

The primary processes performed in Building 7856 include transfer of LLLW between the storage tanks and the Intervalley Transfer Pipeline (a 6,000+ long double-contained pipeline with associated valve boxes that provides connections between Buildings 2537, 7830, and 7856), transfer of LLLW between tanks within Building 7856, and storage of LLLW.

Column 1 – Bounding Accidents

<u>Pressurized releases (event 7856-18)</u>

The Liquid Low-level Waste (LLLW) System consists primarily of a number of tanks and pumps in ventilated vaults at various facilities. LLLW can be pumped from tanks at one facility to the tanks at another through long lengths of transfer pipelines that are not in ventilated enclosures. The bounding spill/leak event involves a pressurized release of LLLW during specific and infrequent (i.e., less than once a year) transfers due to a component failure or operator errors. The release could be inside a vault that has high-efficiency particulate air (HEPA) filtered ventilation or along the length of transfer pipeline directly to the environment. The unmitigated hazard evaluation (UHE) for the LLLW System evaluated spills/leaks that could occur in these systems due to various causes and listed candidate controls that might be available to reduce the risk of the event. The vault ventilation systems and HEPA filters were identified as candidate controls for those events where the LLLW could be released into an intact vault. The vault ventilation systems and HEPA filters were not identified as candidate controls for events that are initiated by or involve a breech of the vault (e.g., vault collapse due to external impact).

The UHE assumed all material made airborne would be released directly to the environment with no credit for any holdup or filtration (i.e., all leakpath factors were assumed to be 1.0). Events with significant consequences to any receptor were carried forward and evaluated in the mitigated hazard evaluate (MHE) to determine which candidate controls would be credited to reduce the risk of the event. Only pressurized releases of LLLW during pumping were identified as having the potential for significant consequences to any receptor (collocated worker only). All non-pressurized releases are of such low consequence to all receptors that identification of controls to reduce risk was not considered necessary and they were screened from further evaluation.

During selection of controls in the MHE, it was determined that the only candidate controls that would be effective in reducing the risk of spills/leaks in any location along the transfer pathway were (1) the work control process to reduce the frequency of operator errors, and (2) equipment to identify a spill/leak had occurred and allow for immediate termination of the transfer. Immediately terminating the transfer prevents the release of a significant quantity of LLLW whether the release occurs inside or outside a vault and whether the vault is intact or not intact.

Fires (event 7856-13)

The bounding fire event involves the ignition of hydrogen or contaminated organic materials in the vapor space of one of the large LLLW storage tanks. The LLLW is contained within the steel tanks in concrete vaults containing little or no combustible materials or in buried steel pipelines. Therefore, no other fires of any significance were identified. The UHE for the LLLW System evaluated fires that could occur due to various causes and listed candidate controls that might be available to reduce the risk of the event. The tank ventilation systems were identified as candidate controls that could act to prevent accumulation of combustible vapors in the tank vapor space. However, all fire events are of such low consequence to all receptors that identification of credited controls to reduce the risk was not considered necessary and they were screened from further evaluation.

Column 2 – Type Confinement

The ventilation system for Bldg. 7856 is an active HEPA filtered exhaust system. Two HVAC systems provide confinement functions for Building 7856: the vault ventilation system and the tank ventilation system. 1) The vault ventilation system provides once-through ventilation for each of the six tank vaults and for the pump and valve vault. Outside air is drawn into one of two inlet filter units located on the south side of Building 7856 before being routed to the tank vaults and the pump and valve vault. The exhaust ducts from the tank vaults join in a header in the pump and valve vault. Eight exhaust registers in the pump and valve vault also join in a header. The two exhaust headers exit the pump and valve vault and join in the exhaust filter and fan area located on the north side of Building 7856. The total air flow is then directed to one of two exhaust filter units where it passes through a prefilter and a HEPA filter. Air flow exiting the exhaust filter unit is directed to one of two exhaust fans and then to the elevated facility exhaust stack. 2) The tank ventilation system provides once-through ventilation for the six 100,000-gal storage tanks located in Building 7856. Outside air is drawn in through one of two inlet filter units located on the south side before being routed to the individual storage tanks. The air in the exhaust header is directed to one of two exhaust filter units located on the north side of Building 7856. Air flow is then drawn through one of two exhaust fans and exits the facility through the elevated facility stack downstream of the vault ventilation exhaust duct work.

Column 3 – Doses (Bounding Unmitigated and Mitigated)

Methodology

Potential radiological consequences from inhalation were determined (LLLW Documented Safety Analysis (DSA), Section 3.3.2.4.1)) by using 95^{th} percentile relative concentrations (X/Q values) calculated consistent with Nuclear Regulatory Commission (NRC) Regulatory Guide 1.145 as recommended by DOE-STD-3009-94, Appendix A. Releases were modeled using straight-line Gaussian dispersion characteristics. All releases were assumed to be at ground level and to exhibit normal buoyancy. The calculation of the 95^{th} percentile X/Q for each location is documented in DAC-LGWO-2002-001.

The inhalation dose from radioactive materials is determined by calculating the integral of air concentration for the time during which the receptor is exposed, multiplying by the breathing rate of the individual, and then multiplying by the dose conversion factor for the radioactive material of interest. The following equations were used:

$$I = Q * X/Q$$

where: I = time integral of air concentration (Ci-sec/m^3)
Q = the activity released to the air (Ci)
X/Q = location-specific relative concentration (sec/m^3)

$$Q = dQ/dt * t$$

where: t = lesser of the duration of the release and the receptor exposure time(s)

$$dQ/dt = RR * C * RRF$$

where: RRF = ARF x RF (from DOE HDBK-3010-94)
ARF = airborne release fraction
RF = respirable fraction
RR = liquid release rate (L/s)
C = liquid concentration (Ci/L)
RRF = respirable release fraction

$$D = I * B_r * DCF$$

where: D = dose (rem)
B_r = breathing rate (m^3/s)
DCF = dose conversion factor (rem/Ci)

The following assumptions are applied to the calculation of inhalation dose:

- The off-site receptor exposure time is 2 hours.
- The on-site receptor exposure time is 8 hours.
- Releases are at ground level (yields higher consequences than elevated releases).
- Receptor breathing rates are 1.2 m^3/h.
- Bounding ARFs and RFs from DOE HDBK-3010-94 are selected for the type of accident and material involved.

The calculation of unmitigated dose due to each evaluated accident is documented in DAC- LGWO-2002-002. Mitigated doses were evaluated qualitatively given the unmitigated dose and the estimated effectiveness of the credited controls.

Spill/leak (event 7856-18)

The areas into which release may occur are not occupied. Any facility workers that may be near the facility are assumed to evacuate and were evaluated as collocated workers. The unmitigated estimate of the radiological consequences to the collocated worker was estimated to be between 25 rem and 100 rem. The unmitigated estimate of the radiological consequences to the public was estimated to be <1 rem. The mitigated dose to the collocated worker is estimated to be <25 rem due to operator action to terminate the transfer. No estimate of the mitigated dose to the public was required or made in the DSA, but would remain < 1 rem.

Fires (event 7856-13)

The areas into which release may occur are not occupied. Any facility workers that may be near the facility are assumed to evacuate and were evaluated as collocated workers. The unmitigated estimate of the radiological consequences to the collocated worker was estimated to be < 25 rem. The unmitigated estimate of the radiological consequences to the public was estimated to be <1 rem. No estimate of the mitigated dose to the collocated worker or public was required or made in the DSA.

Column 4 – Confinement Classification

The system is classified as a candidate control that is considered a defense-in-depth feature for pressurized releases during a transfer.

Column 5 - Function

Spill/leak (event 7856-18)

The vault ventilation system reduces the consequence of a release of LLLW inside an intact tank, pump, or valve vault that results in an inhalation hazard to collocated workers.

Fires (event 7856-13)

The tank ventilation system prevents the accumulation of combustible vapors/gases that could result in a fire in a tank vapor space. A fire in the tank vapor space is of such low consequences that this function is considered to be limited to contamination control rather than any significant reduction in consequences to on-site or off-site receptors.

Column 6 – Functional Requirements

The operability limits for the HEPA filter system are established to ensure the tanks are maintained at a negative pressure with respect to the tank vaults during normal operations, the vaults are maintained at a negative pressure with respect to the atmosphere during normal operation, and the HEPA filters are capable of removing most airborne particulates. The combination of HEPA filter efficiency and limits on differential pressure across the filters ensure that releases will be adequately filtered. Since the HEPA filter system is a DID control that is not credited for reducing event consequences due to pressurized releases and only provides contamination control for other events, no specific performance or filtering criteria are established. (Ref.1, Section 4.4.2.3)

Column 7 – Performance Criteria

Initial design and construction for each element was in general accordance with the Code of Record (e.g., UBC) for general use or low hazard facilities in effect at the time of construction. Because portions of the system were intended for general use only, the ventilation system is not expected or known to be capable of performing its function other than during normal operations. Therefore, current performance criteria are in accordance with the general Safety Management Program (SMP) requirements for general use ventilation systems.

The ventilation system is operated in accordance with the general performance criteria established in the Safety Management Programs, which establish requirements for operations in accordance with approved procedures and periodic inspections and testing. The system is operated in accordance with the facility operating procedures (WM-LGWO-610.3.6), which establishes the response to high and low differential pressure across the filters as well as the requirements to maintain the vessels at a higher negative pressure than their vaults, and for the vaults to be maintained negative relative to atmosphere.

The filters are subject to a percentage of the filters used being 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 dioctyl phthalate (DOP) 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.

Column 8 – Compensatory Measures

No vulnerabilities have been identified that would impact the ventilation system's ability to meet the above performance criteria. Therefore, no compensatory measures are identified.

APPENDIX B

Table 5-1, Ventilation System Performance Criteria – For Bldg. 2537.

Evaluation Criteria	Defense-in-Depth/Other	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.	Per facility procedure WM-LGWO-611.3.1: • Off-gas (primary) for tanks at Bldg. 2537: -0.5 to -2.0 in. H_2O • Cell ventilation (secondary) for tank vaults: approx. -0.4 in H_2O This satisfies the evaluation criteria.	DOE-HDBK-1169 (2.2.9), ASHRAE Design Guide

Evaluation Criteria	Defense-in-Depth/Other	Evaluation Criteria Explained	System Capabilities and Characteristics	Reference
	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 ventilation system provides off-gas (primary) and cell ventilation (secondary) for tanks and vaults associated with the collection, transfer, and storage of liquid low-level waste. LLLW routinely has a basic pH, although some waste is received that has an acidic pH prior to being neutralized with sodium hydroxide. The ventilation systems are compatible with these materials. The HEPA filter housings and ductwork at Bldg. 2537 are of 304L stainless steel construction; some of the ductwork associated with transporting the filtered air to the 3039 Stack is made of transite. Electrical components associated with the ventilation system, such as fan motors which are located outdoors, are compatible with the service environment. While some ductwork does not meet the recommendation for all welded construction using stainless or carbon steel, the materials used are compatible with the anticipated environment, which satisfies the evaluation criteria.	DOE-HDBK-1169 (2.2.5), ASME AG-1

Evaluation Criteria	Defense-in-Depth/Other	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 vault ventilation systems are non-credited defense-in-depth, no specific functional requirements were defined in the DSA and none are implied by the Unmitigated Hazard Evaluation (UHE). Because many portions of the system were intended for general use only and are known to have limited capability to remain intact under accident conditions (e.g., 3039 Stack), the ventilation system is not expected or known to be capable of performing its function other than during normal operations.
			
			The 3039 Stack ventilation system, which provides ventilation service to Bldg. 2537, is a separate, non-nuclear categorized facility. The 3039 Stack ventilation system includes a backup diesel generator to provide backup electrical power to the electric fans; and backup, steam-turbine driven fans are also available that are designed to automatically begin operation in the event of any electric fan shutting down.
			
			No formal evaluation of the system has been performed to determine its ability to maintain confinement integrity during normal, abnormal, and accident conditions. The system is expected to remain operational and maintain confinement integrity during normal operations (which include a pressurized release of LLLW within the vaults at 2537) unless the accident initiator damages the confinement boundary (e.g. – earthquake, missile impact on ductwork or fan, etc).
			
			The defense-in-depth function only includes operability under the as-designed configuration (normal operation, including pressurized releases within the vaults) because no further performance requirements were implied. Based on this, the intent of the evaluation criteria is satisfied.
				DOE-HDBK-1169 (2.4), ASHRAE Design Guide

Evaluation Criteria	Defense-in-Depth/Other	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.	Cell ventilation air inlets have installed prefilters (minimum filter efficiency of 90%) and the off-gas air inlets have installed HEPA filters (minimum filter efficiency of 99%). The cell ventilation and off-gas effluent is exhausted through HEPA filters. The DSA does not specify filter efficiency, but the HEPA filters have a minimum efficiency of 99% as tested by the site DOP testing program. The HEPA filters are subject to DOP testing on a prescribed frequency (as well as after filter changeouts). In addition, the pressures across the HEPA filters are continuously monitored. This satisfies the evaluation criteria.	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.	Differential pressures are monitored for Bldg. 2537 and the associated HEPA filters located at Bldg. 2568. These have both local indicators/alarms, as well as monitoring/alarm capability at remote locations (i.e. – the Waste Operations Control Center). Operation of the 3039 Stack ventilation system fans is monitored at local controls within the 3039 Stack Area. A general facility alarm is sent to the Waste Operations Control Center (WOCC) in the event of problems with the 3039 Stack system, and a field operator is dispatched to determine the specific cause of the alarm (i.e. – normal power feed failure, failure of an electric fan, etc). The WOCC and field operations are a 24/7, 365 day operation. The intent of the evaluation criteria is satisfied.	DOE-HDBK-1169, ASHRAE Design Guide (Section 4), ASME AG-1

Evaluation Criteria	Defense-in-Depth/Other	Evaluation Criteria Explained	System Capabilities and Characteristics	Reference
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)
Post-accident indication of filter break-through	Does Not Apply	While reference does discuss post-accident monitoring, it does not post-accident indication of filter break-through.	Does not apply.	DNFSB/TECH-34

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 vault ventilation systems are non-credited defense-in-depth, no specific functional requirements were defined in the DSA and none are implied by the UHE. Because many portions of the system were intended for general use only and are known to have limited capability to remain intact under accident conditions (e.g., 3039 Stack), the ventilation system is not expected or known to be capable of performing its function other than during normal operations.
			
			The DSA does not credit any of the ventilation system associated with Bldg. 2537 operations to provide any accident mitigation.
			
			The 3039 Stack ventilation system, which provides ventilation service to Bldg. 2537, is a separate, non-nuclear categorized facility. The 3039 Stack ventilation system includes a backup diesel generator to provide backup electrical power to the electric fans; and backup, steam-turbine driven fans are also available that are designed to automatically begin operation in the event of any electric fan shutting down. The 3039 Stack ventilation system has provided reliable service for over 20 years, with no unscheduled interruption of service to Bldg. 2537 during this period.
				DOE-HDBK-1169 (2.4)

Evaluation Criteria	Defense-in-Depth/Other	Evaluation Criteria Explained	System Capabilities and Characteristics	Reference
			The defense-in-depth function only includes operability under the as-designed configuration (normal operation, including pressurized releases within the vaults) because no further performance requirements were implied. Based on this, the evaluation criteria is satisfied.	
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)	System is equipped with weighted back-draft dampers to prevent release through air inlets. System alignment uses manual valves, so that ventilation flow path to the HEPA filters is maintained open even if there is a failure of the exhaust fans. The evaluation criteria is satisfied.	DOE-HDBK-1169 (2.4)

Evaluation Criteria	Defense-in-Depth/Other	Evaluation Criteria Explained	System Capabilities and Characteristics	Reference
System should withstand credible fire events and be available to operate and maintain confinement	Does Not Apply	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 should be provided within all process areas • The final filter housing should be separated from the general building area by fire-rated 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 wall after a 2-hour fire exposure.	Does not apply.	DOE-HDBK-1169 (10.1), DOE-STD-1066

Evaluation Criteria	Defense-in-Depth/Other	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 ventilation system provides ventilation for vessels containing liquid wastes and for vaults containing pumps, valves, piping, and liquid waste storage tanks. These areas are controlled radiological areas not subject to routine entry and therefore flammable dust and debris into these areas is restricted. The ductwork, much of which is located below-grade, is not subject to inspection for dust and debris. There are no fire-rated boundaries associated with the facility. The ductwork and HEPA filter housings are constructed of steel. However, the discharge from the filters is routed through below-grade non-combustible transite ducts to the 3039 Stack Ventilation System before discharge through the 3039 Stack to the environment. Wood filter casings are not used. The intent of the evaluation criteria is satisfied.	DOE-HDBK-1169 (10.1), DOE STD 1066

Evaluation Criteria	Defense-in-Depth/Other	Evaluation Criteria Explained	System Capabilities and Characteristics	Reference
System should safely withstand earthquakes	Does Not Apply	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.	Does not apply.	DOE-HDBK-1169 (9.2), DOE O420.1B, ASME AG-1 AA

Evaluation Criteria	Defense-in-Depth/Other	Evaluation Criteria Explained	System Capabilities and Characteristics	Reference
System should safely withstand tornado depressurization	Does Not Apply	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.	Does not apply.	DOE-HDBK-1169 (9.2), DOE O420.1B

Evaluation Criteria	Defense-in-Depth/Other	Evaluation Criteria Explained	System Capabilities and Characteristics	Reference
System should withstand design wind effects on system performance	Does Not Apply	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.	Does not apply.	DOE-HDBK-1169 (9.2), DOE O420.1B
System should withstand other natural phenomenon events considered credible in the DSA where system is credited	Does Not Apply	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.	Does not apply.	DOE-HDBK-1169 (9.2), DOE O420.1B

Evaluation Criteria	Defense-in-Depth/Other	Evaluation Criteria Explained	System Capabilities and Characteristics	Reference
Administrative controls to protect system from barrier-threatening events	Does Not Apply	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.	Does not apply.	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.	All HEPA filters are subject to DOP testing on a scheduled frequency. BJC contracts for the testing to be done by the primary site contractor's ORNL Site Quality Engineering and Inspection organization per ASME N510. The site organization uses a site-specific database, known as Datastream, to schedule filters for periodic DOP testing. Filters are also DOP tested after filter changeouts are completed. Results of DOP testing are provided to the facility management. A minimum acceptable efficiency of 99.95% when tested with an aerosol of essentially mono-dispersed 0.3 micron particles is used by the testing organization during the in-place test. The evaluation criteria are satisfied.	DOE-HDBK-1169 (2.3.8), ASME AG-1, ASME N510
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.	Instrumentation associated with the ventilation system is calibrated and tested in accordance with approved maintenance procedures (contained in the WM-LGWO-614 procedure series) that are based on manufacturer's calibration and testing recommendations/procedures. The evaluation criteria are satisfied.	DOE-HDBK-1169 (2.3.8)

Evaluation Criteria	Defense-in-Depth/Other	Evaluation Criteria Explained	System Capabilities and Characteristics	Reference
Integrated system performance testing is specified and performed	Does Not Apply	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.	Does not apply.	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 of date of installation, or when the TSR DP limit is reached—whichever occurs first. Since the ventilation system is only defense-in-depth, no changeout of filters based on service life is required. The differential pressure is monitored for the filters, and the filters are changed out based on high differential pressure or a failed DOP test. Significant radiological loading is not expected; however, the contact dose rate will be monitored periodically, and a change-out based on ALARA considerations would be performed if conditions warrant. Since the BJC policy does not require that filter service life be used for defense-in-depth filters, the evaluation criteria is not 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 Defense-in-Depth Systems.)	Does not apply.	DOE O420.1B, Chapter I, Sec. 3.b(8)

Evaluation Criteria	Defense-in-Depth/Other	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 safety-significant 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.	Does not apply.	DOE-HDBK-1169 (2.2.7)
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 safety-significant air cleaning systems.	Does not apply.	DOE-HDBK-1169 (2.2.7)
Other specific functional requirements credited in the DSA	Does Not Apply	There are no other specific functional requirements credited in the DSA.	Does not apply.	10 CFR 830, Subpart B

Table 5-1, Ventilation System Performance Criteria – For Bldg. 7830.

Evaluation Criteria	Defense-in-Depth/Other	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.	Per facility procedure WM-LGWO-610.3.1: • Off-gas (primary) for tanks at Bldg. 7830: -0.5 to -2.0 in. H_2O • Cell ventilation (secondary) for tank vaults: -0.1 to -0.5 in. H_2O (with tanks on off-gas adjusted to be more negative than the tank vaults) This 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 ventilation system provides off-gas (primary) and cell ventilation (secondary) for tanks and vaults associated with the transfer and storage of liquid low-level waste. LLLW routinely has a basic pH, although some waste is received that has an acidic pH prior to being neutralized with sodium hydroxide. The ventilation systems are compatible with these materials. The HEPA filter housings and ductwork at Bldg. 7830 are of 304L stainless steel construction. Electrical components associated with the ventilation system, such as fan motors which are located outdoors, are compatible with the service environment. This satisfies the evaluation criteria.	DOE-HDBK-1169 (2.2.5), ASME AG-1

Evaluation Criteria	Defense-in-Depth/Other	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 vault ventilation systems are non-credited defense-in-depth, no specific functional requirements were defined in the DSA and none are implied by the Unmitigated Hazard Evaluation (UHE). Because portions of the system were intended for general use only, the ventilation system is not expected or known to be capable of performing its function other than during normal operations.
			
			No formal evaluation of the system has been performed to determine its ability to maintain confinement integrity during normal, abnormal, and accident conditions. The system is expected to remain operational and maintain confinement integrity in the event during normal operations which include a pressurized release of LLLW within the vaults at 7830 unless the accident initiator damages the confinement boundary (e.g. – earthquake, missile impact on ductwork or fan, etc).
			
			The defense-in-depth function only includes operability under the as-designed configuration (normal operation, including pressurized releases within the vaults) because no further performance requirements were implied. Based on this, the intent of the evaluation criteria is satisfied.
				DOE-HDBK-1169 (2.4), ASHRAE Design Guide

Evaluation Criteria	Defense-in-Depth/Other	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.	Cell ventilation air inlets have installed prefilters (minimum filter efficiency of 90%) and the off-gas air inlets have installed HEPA filters (minimum filter efficiency of 99%). The DSA does not specify filter efficiency, but the HEPA filters have a minimum efficiency of 99% as tested by the site DOP testing program. The cell ventilation and off-gas effluent is exhausted through HEPA filters. The HEPA filters are subject to DOP testing on a prescribed frequency (as well as after filter changeouts). In addition, the pressures across the HEPA filters are continuously monitored. This satisfies the evaluation criteria.	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.	Differential pressures are monitored for Bldg. 7830 and are recorded daily (365 days per year). Operation of the 7830 ventilation system fans is monitored at local controls at Bldg. 7830. High pressure for the tank off-gas (where the tank off-gas is going to atmospheric instead of being maintained negative) is indicated and alarmed locally. A general facility alarm is sent to the Waste Operations Control Center (WOCC) in the event of a high pressure alarm for the tanks, and a field operator is dispatched to determine the specific cause of the alarm (i.e. –power failure, failure of a fan, etc). The WOCC and field operations are a 24/7, 365 day operation. The intent of the evaluation criteria is satisfied.	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)

Evaluation Criteria	Defense-in-Depth/Other	Evaluation Criteria Explained	System Capabilities and Characteristics	Reference
Post-accident indication of filter break-through	Does Not Apply	While reference does discuss post-accident monitoring, it does not post-accident indication of filter break-through.	Does not apply.	DNFSB/TECH-34

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 vault ventilation systems are non-credited defense-in-depth, no specific functional requirements were defined in the DSA and none are implied by the UHE. Because portions of the system were intended for general use only, the ventilation system is not expected or known to be capable of performing its function other than during normal operations.
			
			System is designed with one fan providing cell ventilation for the east tank vault and one fan providing cell ventilation for the west tank vault. One fan provides off-gas for the four tanks located in the east tank vault and one fan provides off-gas for the four tanks located in the west tank vault. There is a cross-connect provided so that one fan can provide either all of the off-gas or all of the cell ventilation in the event a fan fails or has to be removed from service for maintenance. No alternate power sources (i.e. – diesel generator) or steam turbine-driven fans are available. The system has provided reliable service since being placed in service in 1982.
			
			The DSA does not credit any of the ventilation system associated with Bldg. 7830 operations to provide any accident mitigation.
			
			The defense-in-depth function only includes operability under the as-designed configuration (normal operation, including pressurized releases within the vaults) because no further performance
				DOE-HDBK-1169 (2.4)

Evaluation Criteria	Defense-in-Depth/Other	Evaluation Criteria Explained	System Capabilities and Characteristics	Reference
			requirements were implied. Based on this, the evaluation criteria is satisfied.	
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)	System is equipped with weighted back-draft dampers to prevent release through air inlets. Flame arrestors are also installed prior to the exhaust HEPA filters on the tank off-gas system. System alignment uses manual valves, so that ventilation flow path to the HEPA filters is maintained open even if there is a failure of the exhaust fans. The evaluation criteria is satisfied.	DOE-HDBK-1169 (2.4)

Evaluation Criteria	Defense-in-Depth/Other	Evaluation Criteria Explained	System Capabilities and Characteristics	Reference
System should withstand credible fire events and be available to operate and maintain confinement	Does Not Apply	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 should be provided within all process areas • The final filter housing should be separated from the general building area by fire-rated 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 wall after a 2-hour fire exposure.	Does not apply.	DOE-HDBK-1169 (10.1), DOE-STD-1066

Evaluation Criteria	Defense-in-Depth/Other	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 ventilation system provides ventilation for vessels containing liquid wastes and for vaults containing pumps, valves, piping, and liquid waste storage tanks. These areas are controlled radiological areas not subject to routine entry and therefore flammable dust and debris into these areas is restricted. The ductwork, much of which is located below-grade, is not subject to inspection for dust and debris. There are no fire-rated boundaries associated with the facility. Flame arrestors are also installed prior to the exhaust HEPA filters on the tank off-gas system. The ductwork and HEPA filter housings are constructed of steel. Wood filter casings are not used. The evaluation criteria is satisfied.	DOE-HDBK-1169 (10.1), DOE STD 1066

Evaluation Criteria	Defense-in-Depth/Other	Evaluation Criteria Explained	System Capabilities and Characteristics	Reference
System should safely withstand earthquakes	Does Not Apply	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.	Does not apply.	DOE-HDBK-1169 (9.2), DOE O420.1B, ASME AG-1 AA

Evaluation Criteria	Defense-in-Depth/Other	Evaluation Criteria Explained	System Capabilities and Characteristics	Reference
System should safely withstand tornado depressurization	Does Not Apply	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.	Does not apply.	DOE-HDBK-1169 (9.2), DOE O420.1B

Evaluation Criteria	Defense-in-Depth/Other	Evaluation Criteria Explained	System Capabilities and Characteristics	Reference
System should withstand design wind effects on system performance	Does Not Apply	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.	Does not apply.	DOE-HDBK-1169 (9.2), DOE O420.1B
System should withstand other natural phenomenon events considered credible in the DSA where system is credited	Does Not Apply	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.	Does not apply.	DOE-HDBK-1169 (9.2), DOE O420.1B

Evaluation Criteria	Defense-in-Depth/Other	Evaluation Criteria Explained	System Capabilities and Characteristics	Reference
Administrative controls to protect system from barrier-threatening events	Does Not Apply	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.	Does not apply.	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.	All HEPA filters are subject to DOP testing on a scheduled frequency. BJC contracts for the testing to be done by the primary site contractor's ORNL Site Quality Engineering and Inspection organization per ASME N510. The site organization uses a site-specific database, known as Datastream, to schedule filters for periodic DOP testing. Filters are also DOP tested after filter changeouts are completed. Results of DOP testing are provided to the facility management. A minimum acceptable efficiency of 99.95% when tested with an aerosol of essentially mono-dispersed 0.3 micron particles is used by the testing organization during the in-place test. The evaluation criteria are satisfied.	DOE-HDBK-1169 (2.3.8), ASME AG-1, ASME N510
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.	Instrumentation associated with the ventilation system is calibrated and tested in accordance with approved maintenance procedures (contained in the WM-LGWO-614 procedure series) that are based on manufacturer's calibration and testing recommendations/procedures. The evaluation criteria are satisfied.	DOE-HDBK-1169 (2.3.8)

Evaluation Criteria	Defense-in-Depth/Other	Evaluation Criteria Explained	System Capabilities and Characteristics	Reference
Integrated system performance testing is specified and performed	Does Not Apply	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.	Does not apply.	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 of date of installation, or when the TSR DP limit is reached—whichever occurs first. Since the ventilation system is only defense-in-depth, no changeout of filters based on service life is required. The differential pressure is monitored for the filters, and the filters are changed out based on high differential pressure or a failed DOP test. Significant radiological loading is not expected; however, the contact dose rate will be monitored periodically, and a change-out based on ALARA considerations would be performed if conditions warrant. Since the BJC policy does not require that filter service life be used for defense-in-depth filters, the evaluation criteria is not 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 Defense-in-Depth Systems.)	Does not apply.	DOE O420.1B, Chapter I, Sec. 3.b(8)

Evaluation Criteria	Defense-in-Depth/Other	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 safety-significant 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.	Does not apply.	DOE-HDBK-1169 (2.2.7)
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 safety-significant air cleaning systems.	Does not apply.	DOE-HDBK-1169 (2.2.7)
Other specific functional requirements credited in the DSA	Does Not Apply	There are no other specific functional requirements credited in the DSA. **[Verify for each system]**	Does not apply.	10 CFR 830, Subpart B

Table 5-1, Ventilation System Performance Criteria – for Bldg. 7856.

Evaluation Criteria	Defense-in-Depth/Other	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.	Per facility operator aid LGWO-OA-060 (approximate values for HVAC system balancing): • Primary off-gas for the tanks: -5.0 in. H_2O • Secondary (cell ventilation): o Tank Vaults Cell Ventilation: -2.0 in. H_2O o Pump/Valve Vault: -2.5 in. H_2O This 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 ventilation system provides off-gas (primary) and cell ventilation (secondary) for tanks and vaults associated with the collection, transfer, and storage of liquid low-level waste. LLLW routinely has a basic pH, although some waste is received that has an acidic pH prior to being neutralized with sodium hydroxide. The ventilation systems are compatible with these materials. The HEPA filter housings and ductwork at Bldg. 7856 are of 304L stainless steel construction. Electrical components associated with the ventilation system, such as fan motors which are located outdoors, are compatible with the service environment. This satisfies the evaluation criteria.	DOE-HDBK-1169 (2.2.5), ASME AG-1

Evaluation Criteria	Defense-in-Depth/Other	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 vault ventilation systems are non-credited defense-in-depth, no specific functional requirements were defined in the DSA and none are implied by the Unmitigated Hazard Evaluation (UHE). Because many portions of the system were intended for general use only, the ventilation system is not expected or known to be capable of performing its function other than during normal operations.
			
			Redundant fans are provided at the facility. No alternate power sources are provided.
			
			No formal evaluation of the system has been performed to determine its ability to maintain confinement integrity during normal, abnormal, and accident conditions. The system is expected to remain operational and maintain confinement integrity during normal operations (which include a pressurized release of LLLW within the vaults at 7856) unless the accident initiator damages the confinement boundary (e.g. – earthquake, missile impact on ductwork or fan, etc).
			
			The defense-in-depth function only includes operability under the as-designed configuration (normal operation, including pressurized releases within the vaults) because no further performance requirements were implied. Based on this, the intent of the evaluation criteria is satisfied.
				DOE-HDBK-1169 (2.4), ASHRAE Design Guide

Evaluation Criteria	Defense-in-Depth/Other	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.	Cell ventilation air inlets have installed prefilters (minimum filter efficiency of 90%) and the off-gas air inlets have installed HEPA filters (minimum filter efficiency of 99 %). The cell ventilation and off-gas effluent is exhausted through HEPA filters. The DSA does not specify filter efficiency, but the HEPA filters have a minimum efficiency of 99% as tested by the site DOP testing program. The HEPA filters are subject to DOP testing on a prescribed frequency (as well as after filter changeouts). In addition, the pressures across the HEPA filters are continuously monitored. This satisfies the evaluation criteria.	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.	Differential pressures as well as fan status are monitored for Bldg. 7856. These have both local indicators/alarms, as well as monitoring/alarm capability at remote locations (i.e. – the Waste Operations Control Center (WOCC)). If an alarm is received at the WOCC, a field operator will be dispatched to determine the specific cause of the alarm (i.e. –power feed failure, failure of an electric fan, etc). The WOCC and field operations are a 24/7, 365 day operation. This satisfies the evaluation criteria.	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)
Post-accident indication of filter break-through	Does Not Apply	While reference does discuss post-accident monitoring, it does not post-accident indication of filter break-through.	Does not apply.	DNFSB/TECH-34

Evaluation Criteria	Defense-in-Depth/Other	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 vault ventilation systems are non-credited defense-in-depth, no specific functional requirements were defined in the DSA and none are implied by the UHE. Because many portions of the system were intended for general use only, the ventilation system is not expected or known to be capable of performing its function other than during normal operations.
			
			Redundant fans are provided for the cell ventilation and off-gas system. No alternate power sources are available at 7856. The 7856 ventilation system has provided reliable service since it was placed in service in 1998.
			
			The DSA does not credit any of the ventilation system associated with Bldg. 7856 operations to provide any accident mitigation.
			
			The defense-in-depth function only includes operability under the as-designed configuration (normal operation, including pressurized releases within the vaults) because no further performance requirements were implied. Based on this, the intent of the evaluation criteria is satisfied.
				DOE-HDBK-1169 (2.4)

Evaluation Criteria	Defense-in-Depth/Other	Evaluation Criteria Explained	System Capabilities and Characteristics	Reference
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)	Cell ventilation system is equipped with weighted back-draft dampers to prevent release through air inlets. The tanks are equipped with a common relief header to the pump and valve vault. A separate line from the header is equipped with a rupture disk set at 11.4 psig. In the event of HVAC failures such that the tank ventilation system is pressurized, this line opens to the pump and valve vault. System alignment uses manual valves, so that ventilation flow path to the HEPA filters is maintained open even if there is a failure of the exhaust fans. The evaluation criteria is satisfied.	DOE-HDBK-1169 (2.4)

Evaluation Criteria	Defense-in-Depth/Other	Evaluation Criteria Explained	System Capabilities and Characteristics	Reference
System should withstand credible fire events and be available to operate and maintain confinement	Does Not Apply	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 should be provided within all process areas • The final filter housing should be separated from the general building area by fire-rated 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 wall after a 2-hour fire exposure.	Does not apply.	DOE-HDBK-1169 (10.1), DOE-STD-1066

Evaluation Criteria	Defense-in-Depth/Other	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 ventilation system provides ventilation for vessels containing liquid wastes and for vaults containing pumps, valves, piping, and liquid waste storage tanks. These areas are controlled radiological areas not subject to routine entry and therefore flammable dust and debris into these areas is restricted. The ductwork, much of which is located below-grade, is not subject to inspection for dust and debris. There are no fire-rated boundaries associated with the facility. The ductwork and HEPA filter housings are constructed of steel. Wood filter casings are not used. The evaluation criteria is satisfied.	DOE-HDBK-1169 (10.1), DOE STD 1066

Evaluation Criteria	Defense-in-Depth/Other	Evaluation Criteria Explained	System Capabilities and Characteristics	Reference
System should safely withstand earthquakes	Does Not Apply	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.	Does not apply.	DOE-HDBK-1169 (9.2), DOE O420.1B, ASME AG-1 AA

Evaluation Criteria	Defense-in-Depth/Other	Evaluation Criteria Explained	System Capabilities and Characteristics	Reference
System should safely withstand tornado depressurization	Does Not Apply	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.	Does not apply.	DOE-HDBK-1169 (9.2), DOE O420.1B

Evaluation Criteria	Defense-in-Depth/Other	Evaluation Criteria Explained	System Capabilities and Characteristics	Reference
System should withstand design wind effects on system performance	Does Not Apply	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.	Does not apply.	DOE-HDBK-1169 (9.2), DOE O420.1B
System should withstand other natural phenomenon events considered credible in the DSA where system is credited	Does Not Apply	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.	Does not apply.	DOE-HDBK-1169 (9.2), DOE O420.1B

Evaluation Criteria	Defense-in-Depth/Other	Evaluation Criteria Explained	System Capabilities and Characteristics	Reference
Administrative controls to protect system from barrier-threatening events	Does Not Apply	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.	Does not apply.	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.	All HEPA filters are subject to DOP testing on a scheduled frequency. BJC contracts for the testing to be done by the primary site contractor's ORNL Site Quality Engineering and Inspection organization per ASME N510. The site organization uses a site-specific database, known as Datastream, to schedule filters for periodic DOP testing. Filters are also DOP tested after filter changeouts are completed. Results of DOP testing are provided to the facility management. A minimum acceptable efficiency of 99.95% when tested with an aerosol of essentially mono-dispersed 0.3 micron particles is used by the testing organization during the in-place test. The evaluation criteria are satisfied.	DOE-HDBK-1169 (2.3.8), ASME AG-1, ASME N510
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.	Instrumentation associated with the ventilation system is calibrated and tested in accordance with approved maintenance procedures (contained in the WM-LGWO-614 procedure series) that are based on manufacturer's calibration and testing recommendations/procedures. The evaluation criteria are satisfied.	DOE-HDBK-1169 (2.3.8)

Evaluation Criteria	Defense-in-Depth/Other	Evaluation Criteria Explained	System Capabilities and Characteristics	Reference
Integrated system performance testing is specified and performed	Does Not Apply	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.	Does not apply.	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 of date of installation, or when the TSR DP limit is reached—whichever occurs first. Since the ventilation system is only defense-in-depth, no changeout of filters based on service life is required. The differential pressure is monitored for the filters, and the filters are changed out based on high differential pressure or a failed DOP test. Significant radiological loading is not expected; however, the contact dose rate will be monitored periodically, and a change-out based on ALARA considerations would be performed if conditions warrant. Since the BJC policy does not require that filter service life be used for defense-in-depth filters, the evaluation criteria is not 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 Defense-in-Depth Systems.)	Does not apply.	DOE O420.1B, Chapter I, Sec. 3.b(8)

Evaluation Criteria	Defense-in-Depth/Other	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 safety-significant 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.	Does not apply.	DOE-HDBK-1169 (2.2.7)
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 safety-significant air cleaning systems.	Does not apply.	DOE-HDBK-1169 (2.2.7)
Other specific functional requirements credited in the DSA	Does Not Apply	There are no other specific functional requirements credited in the DSA. **[Verify for each system]**	Does not apply.	10 CFR 830, Subpart B

APPENDIX C

Field Evaluation Team Biographical Sketches

Karen Balo

Nuclear Facility Safety, Deployed Manager for Waste Management Project
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

Ventilation System, Subject Matter Expert
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.

Jeff Maddox

Senior Engineer, Liquid and Gaseous Waste Operations
Mr. Maddox holds a BS degree in Chemical Engineering and a MS in Business Administration from the University of Tennessee in Knoxville. He is an Engineer-in-Training with over 20 years experience in operations engineering support for the Liquid and Gaseous Waste Operations at the Oak Ridge National Laboratory.

BJC/OR-2866

ACTIVE CONFINEMENT SYSTEM EVALUATION SUMMARY REPORT FOR DNFSB 2004-2

PORTABLE UNITS, OAK RIDGE TENNESSEE

[Subcontractor Name]

contributed to the preparation of this document and should not be considered an eligible contractor for its review.