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Department of Energy
Washington, DC 20585

December 10, 2007

The Honorable A.J. Eggenberger
Chairman
Defense Nuclear Facilities Safety Board
625 Indiana Avenue, NW, Suite 700
Washington, DC 20004-2941

Dear Mr. Chairman:

The purpose of this memorandum is to transmit the Office of Environmental Management's (EM) Low Priority Facility Review Reports identified in Enclosure 1 as the next incremental deliverable to satisfy Commitment 8.6.3 of the *Department of Energy Implementation Plan for Defense Nuclear Facilities Safety Board Recommendation 2004-2, Active Confinement Systems*, July 2006. High priority and medium priority review reports were transmitted to the Board on June 8 and September 10, 2007, respectively.

As over a year has passed since our July 14, 2006, transmittal of the original EM priority listing, project changes have affected that list. A revised listing is included as Enclosure 2 which provides the current status of all low priority facilities on the original listing. Enclosures 3 through 9 are the review report for the current EM low priority facilities. Program Secretarial Officer concurrence and approval of any identified gaps and upgrades, if necessary, will be in accordance with Deliverable 8.6.5.

If you have any comments or feedback, please call me at (202) 586-0738 or Mr. Dae Y. Chung, Deputy Assistant Secretary for Safety Management and Operations, at (202) 586-5151.

Sincerely,

James M. Owendoff
Chief Operations Officer
for Environmental Management

Enclosures

cc:
J. Rispoli, EM-1
I. Triay, EM-2
C. Lagdon, CNS-ESE
M. Whitaker, HS-1

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Enclosure 1

Listing of Enclosures for Low Priority Facility Review Reports

1. Listing of Low Priority Facility Review Reports

2. Recommendation 2004-2 Low Priority Facility Ventilation System Evaluations Status Listing as of November 30, 2007

3. Savannah River National Laboratory Building 773A DNFSB 2004-2 Active Confinement Evaluation (Final Report)

4. Request for Concurrence with Recommendation of the Defense Nuclear Facilities Safety Board (DNFSB) 2004-2 Final Report for the Savannah River Site (SRS) F & H Area Analytical Laboratory

5. Request for Concurrence with Recommendation of the Defense Nuclear Facilities Safety Board (DNFSB) 2004-2 Final Report for the Savannah River Site (SRS) Outside Facilities - H

6. Request for Concurrence with Recommendation of the Defense Nuclear Facilities Safety Board (DNFSB) 2004-2 Final Report for the Savannah River Site (SRS) L-Area Material Storage Facility Disassembly Basin

7. Request for Concurrence with Recommendation of the Defense Nuclear Facilities Safety Board (DNFSB) 2004-2 Final Report for the Savannah River Site (SRS) Solid Waste Management Facilities

8. Evaluation of WIPP Ventilation Systems in Response to DNFSB Recommendation 2004-2

9. Submittal of Confinement Ventilation System Evaluations for the Department of Energy Oak Ridge Office of Environmental Management Low Priority Facilities in Response to Defense Nuclear Facilities Safety Board Recommendation 2004-2

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Recommendation 2004-2: Facility Ventilation System Evaluations
Status Listing as of November 30, 2007

Facility	Site/ Location	Description	Status
773000A Main Tech Lab and Sandfilter	SRS	SNRL Technical NR Facilities	Facility Evaluation complete for Commitment 8.6.3 See Enclosure 3
235000F 235F	SRS	235-F NMS Building, AB-Line, PuFF, PEF, Sandfilter Portions	Excluded per letter, Oct 5, 2006, Peddle to Allison Meets exclusion criteria NB-2 and NB-3. 2004-2 System Evaluation report not required. All 9975/3013 packages have been removed. De-inventory of TRU waste and sealed sources and standards are scheduled for October 2006. Remaining radiological inventory will be in equipment holdup. D&D planning to continue in FY07; D&D expected to begin FY08. Meets non-beneficial criteria NB-2 via CSSC project: Facilities to be replaced with new facilities that (1) have received critical decision (CD) CD-0 (approved mission need) and have remaining CD milestone schedules approved; (2) the replacement facilities are schedules to start operations within 10 years; and (3) the existing facility(ies) will have the radioactive material inventory significantly reduced or eliminated during the 10-year period. Meets non-0beneficial criteria NB-3: Facilities in a surveillance and maintenance mode, with no intrusive activities that are deactivated and awaiting decommissioning activities.
776001A-006A	SRS	Rad Liquid Waste Handling Facility	Excluded per letter, Nov 3, 2006, Peddle to Allison 776-A complex reclassified as a Hazard Category 3 Facility from a Hazard Category 2 Facility as part of SNRL DSA upgrade efforts. Per 2004-2 Implementation Guidance, Hazard Category 3 facilities with active confinement ventilation systems require no further evaluations.

Recommendation 2004-2: Facility Ventilation System Evaluations
Status Listing as of November 30, 2007

Facility	Site/ Location	Description	Status
772000F 772 F Lab	SRS	Analytical Labs NR Facilities (HC 2)	Facility Evaluation complete for Commitment 8.6.3 See Enclosure 4
211000H 211 H	SRS	H Canyon NR Facilities (HC 2) : Outside Facility	Facility Evaluation complete for Commitment 8.6.3 See Enclosure 5
105013K	SRS	K-Area Facilities (HC 3); Waste Storage Building Waste Repack	Excluded per letter, Oct 5, 2006, Peddle to Allison Meets exclusion criteria CE-3. Total storage inventory can be Haz Cat 3. Repackaging involves low level contaminated materials not approaching Haz Cat 3 inventories.
105000L	SRS	SFP Facilities (The basin area is utilized for storage of spent reactor fuel.) (HC 2); L-Reactor Disassem Fuel Storage	Facility Evaluation complete for Commitment 8.6.3 See Enclosure 6
710000B	SRS	Solid Waste NR Facilities (HC 3); Mixed/Hazardous Waste Storage Bldg	Excluded per letter Mar 9, 2007, Spears to Giroir Meets exclusion criteria NB-5: Facilities that have an approved 10 CFR 830 compliant safety basis and are planned by the PSO to reduce their inventory of radioactive material significantly below Hazard Category 3 threshold quantities within 7 years.
643029E	SRS	Solid Waste NR Facilities. (Engineered metal buildings to provide weather protection for interim radioactive and hazardous waste storage.) (HC 3); Mixed Waste Storage	Excluded per letter, Jun 19, 2007, Chung to Allison Meets exclusion criteria CE-3. 2004-2 System Evaluation report not required. Due to mission change, the facility is only used for non-intrusive assaying of containers with no repackaging or reprocessing operations.

Recommendation 2004-2: Facility Ventilation System Evaluations
Status Listing as of November 30, 2007

Facility	Site/ Location	Description	Status
643043E	SRS	Solid Waste NR Facilities (HC-2); Mixed Waste	Excluded per letter, Oct 5, 2006, Peddle to Allison Meets exclusion criteria CE-3. 2004-2 System Evaluation report not required. Due to mission change, the facility is only used for non-intrusive assaying of containers with no repackaging or reprocessing operations. This meets CE-3: Storage facilities where radiological material is entirely in approved containers (e.g., Type 7A drums, standard waste boxes, IP-2 containers) and the building design, when present, is limited to providing weather protection. This includes outside storage facilities, e.g., storage pads and yards, where no repackaging, or intrusive inspection or characterization is allowed. This does not include facilities in which processing or repackaging operations are authorized.
645000N	SRS	Solid Waste NR Facilities (HC 3)	Facility Evaluation complete for Commitment 8.6.3 See Enclosure 7
645002N	SRS	Solid Waste NR Facilities (HC 3); Hazardous Waste	Facility Evaluation complete for Commitment 8.6.3 See Enclosure 7
645004N	SRS	Solid Waste NR Facilities (HC 3)	Facility Evaluation complete for Commitment 8.6.3 See Enclosure 7
260000S	SRS	DWPF NR Facilities (HC 2)	Excluded per Attachment 3 to DWPF 2004-2 Medium Priority Submittal. Meets exclusion criterion CE-4. Facilities with radioactive materials in non-dispersible form (e.g., glass or vitrified waste) and where energetic forces that could result in a release do not exist.

Recommendation 2004-2: Facility Ventilation System Evaluations
Status Listing as of November 30, 2007

Facility	Site/ Location	Description	Status
201000Z	SRS	Saltstone Process/Control NR Facilities (HC 3)	Excluded per letter, Nov 3, 2006, Peddle to Allison Meets exclusion criteria CE-4. Facilities with radioactive materials in non-dispersible form (e.g., glass or vitrified waste) and where energetic forces that could result in a release do not exist.
451001Z	SRS	Saltstone Vaults NR Facilities (HC 3)	Excluded per letter, Nov 3, 2006, Peddle to Allison Meets exclusion criteria CE-4. Facilities with radioactive materials in non-dispersible form (e.g., glass or vitrified waste) and where energetic forces that could result in a release do not exist.
451004Z	SRS	Saltstone Vaults NR Facilities (HC 3)	Excluded per letter, Nov 3, 2006, Peddle to Allison Meets exclusion criteria CD-4. Facilities with radioactive materials in non-dispersible form (e.g., glass or vitrified waste) and where energetic forces that could result in a release do not exist.
CPP-666, Fast Fuel Storage Area (FSA)	INL/INTEC	Underwater storage and handling of spent nuclear fuel (HC 2)	Submitted along with Sep 10, 2007 submission of Medium Priority Facilities
CPP-603, Irradiated Fuel Storage Facility (IFSF)	INL/INTEC	Storage of spent nuclear fuel (HC 2)	Submitted along with Sep 10, 2007 submission of Medium Priority Facilities

Recommendation 2004-2: Facility Ventilation System Evaluations
Status Listing as of November 30, 2007

Facility	Site/ Location	Description	Status
CH-TRU Waste Disposal Facility	WIPP	Above ground facilities for CH-TRU Waste handling and disposal	Facility Evaluation complete for Commitment 8.6.3 See Enclosure 8
CH-TRU Waste Disposal Facility	WIPP	Underground facilities for CH-TRU Waste handling and disposal	Facility Evaluation complete for Commitment 8.6.3 See Enclosure 8
RH-TRU Waste Disposal Facility	WIPP	Above ground facilities for RH-TRU Waste handling and disposal	Facility Evaluation complete for Commitment 8.6.3 See Enclosure 8
RH-TRU Waste Disposal Facility	WIPP	Underground facilities for RH-TRU Waste handling and disposal	Facility Evaluation complete for Commitment 8.6.3 See Enclosure 8
7503 – Molten Salt Reactor Experiment Facility	ORO/ORNL	MSRE is a graphite-moderated, liquid-fueled reactor built in the 1960s to investigate the practicality of the molten salt reactor concept. Material is being removed from the facility in preparation for D&D.	Facility Evaluation complete for Commitment 8.6.3 See Enclosure 9
3517 – Fission Product Development Laboratory	ORO/ORNL	Building 3517 was operated from 1958 until 1989 and was utilized for recovery of long-lived fission products from aqueous waste, purification and pelletization of radiation source materials, and testing of new procedures for source fabrication. Facility is in surveillance and maintenance.	Facility Evaluation complete for Commitment 8.6.3 See Enclosure 9

Recommendation 2004-2: Facility Ventilation System Evaluations
Status Listing as of November 30, 2007

Facility	Site/ Location	Description	Status
Melton Valley TRU Retrieval Project	ORO/ORNL	The scope of this project includes retrieval of remote-handled TRU waste stored below grade in earthen trenches. The waste is retrieved, placed in overpacks, and staged in 5 facilities (four Rubb tents and one partially below grade covered RCRA structure) pending transport to the TRU Waste Processing Facility. TRU retrieval operations have been completed. There are no installed ventilation systems. Facility will be down graded as waste is removed from the facility.	Facility Excluded Per NB-5. – TRU retrieval operations complete and facility is being downgraded..

SEPARATION

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OCT 2 2 2007

SRNL-DIR-2007-00108

Mr. Carl A. Everatt, Director
Office of Safety and Quality Assurance
U. S. Department of Energy
Savannah River Operations Office
P.O. Box A
Aiken, South Carolina 29802

Dear Mr. Everatt:

SAVANNAH RIVER NATIONAL LABORATORY BUILDING 773-A DNFSB 2004-2 ACTIVE CONFINEMENT EVALUATION (FINAL REPORT)

This letter transmits the final report of DNFSB Recommendation 2004-2, Active Confinement Systems for the Savannah River National Laboratory 773-A Facility located at the Savannah River Site. This report is submitted for Site Evaluation Team and Independent Review Panel review and concurrence. The attached report has been generated in accordance with the guidance provided in "Ventilation System Evaluation Guidance for Safety-Related and Non-Safety-Related Systems", Revision 0, January 2006. The Facility Evaluation Team has concurred with the information contained in this transmittal.

If you have any questions or need additional information, please contact Freddie Grimm at 725-5237.

Sincerely,

Cheryl C. Cabbil

Cheryl C. Cabbil
Acting Laboratory Director

ds:ccc
Atts.
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Donald J. Blake, 707-H, 33
John A. Smartt, 703-H, 133
Jerry L. Hansen, 707-H, 39
Michael J. Swain, 773-43A, 202A
Frederick M. Grimm, 773-43A, 221C
J. Scott MacMurray, 773-43A, 148
Kenneth W. Stephens, 730-4B, 313
Andrew M. Vincent, III, 703-H, 17

OCT 2 3 2007

Facility Evaluation Team Concurrence.

John A. Smartt   Date
DOE Safety System Oversight

J. Scott MacMurray   Date
WSRC SRNL FET Lead

SRNL Chief Engineer Concurrence:

Frederick M. Grimm   Date
SRNL Chief Engineer

SRNL-DIR-2007-00108
Revision 0

SAVANNAH RIVER NATIONAL LABORATORY

BUILDING 773-A

DNFSB 2004-2 ACTIVE CONFINEMENT EVALUATION

FINAL REPORT

Revision 0
October, 2007

UNCLASSIFIED
DOES NOT CONTAIN
UNCLASSIFIED CONTROLLED
NUCLEAR INFORMATION
ADC & Reviewing Official
(Name and Title)
Date

Washington Savannah River Company
Savannah River Site
Aiken, SC 29808

Prepared for the U.S. Department of Energy Under Contract Number DEAC09-96-SR18500

SRNL
SAVANNAH RIVER NATIONAL LABORATORY

Table of Contents

TERMS and DEFINITIONS

Active Confinement Ventilation System	A ventilation system that uses mechanical means (e.g., blower) to circulate air within, and remove air from a building or building space through filtration. (DOE-HDBK-1169-2003, DOE Nuclear Air Cleaning Handbook)
Confinement	A building, building space, room, cell, glovebox, or other enclosed volume in which air supply and exhaust are controlled, and typically filtered. (DOE-HDBK-1169-2003, DOE Nuclear Air Cleaning Handbook)
Confinement System	The barrier and its associated systems (including ventilation) between areas containing hazardous materials and the environment or other areas in the facility that are normally expected to have levels of hazardous material lower than allowable concentration limits. (DOE-HDBK-1169-2003, DOE Nuclear Air Cleaning Handbook)
Discretionary Gap	A condition where a specific system feature does not meet the DNFSB 2004-2 Evaluation Guidance expectation but does meet the expectations assumed in the DSA.
Estimate Class	The level of project definition and associated accuracy range for an estimate. Estimate range from Class 5 with 2% project definition and an accuracy range of -30% to +50% to Class 1 estimates with 100% project definition and an accuracy range of -10% to +10%. (AACE.05)
Hazard Category	Designation for facilities after they are categorized by hazard inventory to determine safety document requirements.
Mitigative Function	A feature associated with a system, structure, or component (SSC) or an administrative control (AC) which reduces the negative consequences of an adverse event to ensure adequate protection of workers, the public, and the environment.
Performance Category	A classification based on a graded approach used to establish the NPH design and evaluation requirements for structures, systems and components. (DOE-STD-1021-93, Natural Phenomena Hazards Performance Categorization Guidelines for Structures, Systems and Components)
Preventive Function	A feature associated with a system, structure, or component (SSC) or an administrative control (AC) which reduces the probability of occurrence of an adverse event to ensure adequate protection of workers, the public, and the environment.
Tape-in-place HEPA Filters	HEPA filters that are installed between two ducts that once taped in place, serve as the contaminated ductwork system pressure boundary without an outer protective housing.
Ventilation System	The ventilation system includes the structures, systems, and components required to supply air to, circulate air within, and remove air from a building/facility space by natural or mechanical means. (DOE-HDBK-1169-2003, DOE Nuclear Air Cleaning Handbook).

ACRONYMS

AM	Air Monitoring
ARP	Actinide Removal Project
CA	Contamination Area
CAM	Continuous Air Monitor
CE	Cell Exhaust
CFM	Cubic Feet per Minute
CHEX	Central Hood Exhaust
CPF	Californium Processing Facility
CVS	Confinement Ventilation System
CW	Co-located Worker (100 meters)
D&D	Deactivation & Decommissioning
DF	Decontamination Factor
D/G	Diesel Generator
DNFSB	Defense Nuclear Facilities Safety Board
DOE	Department of Energy
DOE-SR	Department of Energy Savannah River
DSA	Documented Safety Analysis
ΔP	Differential Pressure
EC	Evaluation Criteria
EG	Evaluation Guideline
FET	Facility Evaluation Team
FHSF	Sand Filter Exhaust
HA	Hazard Analysis
HAD	High Activity Drain Exhaust
HC	Hazards Category
HEPA	High Efficiency Particulate Air
HLC	High Level Cell
HV	Heating and Ventilating
HVAC	Heating Ventilation & Air Conditioning (supply system)
ILC	Intermediate Level Cell
I/O	Input/Output
IRP	Independent Review Panel
KAPL	Knolls Atomic Power Laboratory
LAD	Low Activity Drain Exhaust
LHEX	Local Hood Exhaust
MAR	Material at Risk
MCC	Motor Control Center
MREM	Milliroentgen Equivalent Man
MOI	Maximally Exposed Offsite Individual
MSF	Medical Source Facility
NPH	Natural Phenomena Hazard
OGE	Off-Gas Exhaust
OPC	Other Project Costs
OPEX	Operating Expense

ACRONYMS

PC	Performance Category
PHEX	Process Hood Exhaust
RBA	Radiological Buffer Area
REM	Roentgen Equivalent Man
R&D	Research and Development
ROM	Rough Order of Magnitude
RREX	Regulated Room Exhaust
SAAM	Stack Air Activity Monitoring
SC	Safety Class
SED	Separations Equipment Development
SET	Site Evaluation Team
SRNL	Savannah River National Laboratory
SRS	Savannah River Site
SS	Safety Significant
SSC	Structures, Systems and Components
SST	Stainless Steel
TEC	Total Estimated Cost
TPC	Total Project Cost
TSR	Technical Safety Requirements
VAC	Building Central Vacuum
VOC	Volatile Organic Compound
WG	Water Gauge
WSRC	Washington Savannah River Company

EXECUTIVE SUMMARY

Savannah River National Laboratory (SRNL), Department of Energy (DOE) Environmental Management's Corporate Laboratory, provides R&D, analytical, process support and enabling technologies in support of DOE Environmental Management (waste operations, environmental restoration, decontamination and decommissioning, site cleanup and closure), National Nuclear Security Administration (tritium, plutonium disposition, and homeland security), DOE Energy Production and Conservation (hydrogen economy), and other government agencies and commercial customers. SRNL receives and uses limited quantities of radiological and hazardous chemicals as described in the Documented Safety Analysis (DSA) and supporting program documentation in order to provide the requisite services.

This report presents the results of an analysis of the Savannah River National Laboratory Building 773-A active confinement ventilation systems performed by the Facility Evaluation Team (FET). The FET performed this evaluation to satisfy commitments made in response to Defense Nuclear Facilities Safety Board (DNFSB) recommendation 2004-2 in accordance with the guidance provided by DOE.

Based on the Table 4-3 Evaluation Criteria, the FET identified six events that exceeded the 1 rem criteria for the Maximally Exposed Offsite Individual (MOI). No events were identified that exceed the 100 rem criteria for the Co-located Worker (CW). Subsequent application of Table 5-1 screening criteria along with DOE guidance to exclude Natural Phenomena Hazard (NPH) and full facility fire events resulted in the elimination of all but one event (glovebox overpressurization). However, to develop a more complete understanding of the hazards that can be mitigated by an active confinement ventilation system as part of the assessment, the FET elected to include four additional process events in the Table 5-1 Evaluation process.

Using the Safety Class (SC) performance criteria per the DOE evaluation guidance, the FET performed a functional review of 15 active ventilation systems (773-A B/C-CHEX, B/C-PHEX, B/C-HVAC, B/C-RREX, B/C-HV, B/C/F-OGE, E-CE, E-HVAC, E-RREX, E-LHEX, E-HV, F-PHEX, F-HVAC, F-LHEX, and FHSF) serving four of six sections of Building 773-A.

The Table 5-1 evaluation resulted in the identification of 58 gaps for further evaluation. All gaps were determined to be discretionary since they did not constitute a discrepancy between the DSA and field conditions. Scopes and estimates were developed for the closure of the identified gaps. For some gaps, several alternatives were considered for closing the gap. The FET determined that closure of all 58 gaps would require funding in the range of $37M to $107M over a period of 6 to 10 years depending upon gap closure methods selected.

Based on the number and significance of the gaps as well as the estimated cost to close all the gaps, the FET recommends closing 24 of 58 gaps. The gaps recommended for closure could be closed at an estimated cost ranging between $23M to $33M (in FY07 dollars) over a period of 4 to 6 years, contingent upon funding. Closure of the these gaps will provide a discernable improvement in the reliability and effectiveness of the existing integrated active confinement ventilation system for protection of the facility worker and provide a system that could be

credited in the future for protection of the co-located worker. This in turn would provide enhanced protection of the public.

- Based on the original Recommendation 2004-2 report, closure of Gaps 3, 4, and 6 in the near term would provide a Safety Significant primary confinement ventilation system for 773-A Sections B and C. These two sections of the building are the most likely location for a process event with an MOI potential dose greater than 1 rem. The cost range in FY07 dollars to close these three gaps is between $14M and $21M. The schedule duration, if funded as a single project, is between 36 and 42 months. If funded as currently forecast in the SRNL Infrastructure Plan, the work would be completed no sooner than 2017.

- Based on the feedback from the Independent Review Panel (IRP) and DNFSB during the Actinide Removal Project (ARP) Pilot, the following 7 gaps should be closed in the near term at the Functional Classification level of Safety Significant. Closure of these gaps will result in incremental improvements to the performance of the confinement ventilation systems in 773-A Section E:

    - Closure of Gaps 35, 36, 37, 38, 40 and 42 will increase the performance and reliability of the Secondary Confinement Zone Ventilation Systems that support loading and unloading the shielded cells. The cost range in FY07 dollars to close these gaps is between $2.0M and $2.3M. The schedule duration is between 18 and 24 months. Design for this project is already complete and engineered material has been purchased. Funding is needed to complete the construction and start-up phase.

    - Closure of Gap 58 will increase the reliability of the Primary Confinement Zone Ventilation System in Section E for the shielded cells. The cost range in FY07 dollars to close this gap is between $390K and $500K. The schedule duration is between 12 and 18 months. Design for this project is already complete.

- Based on the enduring mission of SRNL in Building 773-A, the following 14 gaps should be closed over the long term at the Functional Classification level of Safety Significant. Closure of these gaps will provide incremental improvements to the performance of the confinement ventilation systems in 773-A:

    - For events with a potential dose to the MOI greater than or equal to 1 rem, the FET recommends closing Gaps 15, 20, 21, 22, 53, 55 and 56 associated with the primary confinement systems in 773-A Sections B, C and F. The cost range in FY07 dollars to close these gaps is $4.6M to $6.5M.

    - For events with a potential dose to the MOI of less than 1 rem, the FET recommends closing Gaps 23, 24, 26, 27 and 39 associated with the primary and secondary confinement systems in 773-A Section E and Gaps 1 and 5 associated with the 773-A Section B/C CHEX. The cost range in FY07 dollars to close these gaps is $2.0M to $3.0M.

Do not close the remaining 34 gaps for one of the following reasons: 1) D&D planning has been initiated for the process or 2) the incremental dose mitigated by closing the gap is insignificant when compared to the cost to close the gap.

1.0 Introduction

1.1 Facility Overview

SRNL Overview

Savannah River National Laboratory (SRNL), Department of Energy (DOE) Environmental Management's Corporate Laboratory, provides R&D, analytical, process support and enabling technologies in support of DOE Environmental Management (waste operations, environmental restoration, decontamination and decommissioning, site cleanup and closure), National Nuclear Security Administration (tritium, plutonium disposition, and homeland security), DOE Energy Production and Conservation (hydrogen economy), and other government agencies and commercial customers. SRNL receives and uses limited quantities of radiological and hazardous chemicals as described in the Documented Safety Analysis (DSA) and supporting program documentation in order to provide the requisite services.

Building 773-A Overview

Building 773-A (Attachment 1 Figure A), the main laboratory of the SRNL, is a nominal 250,000 square foot Hazard Category (HC) 2 Nuclear facility. It is divided into six sections or wings (Sections A through F) as shown in Attachment 1 Figure B. Each section has a minimum of two levels - the main floor and the service floor.

- Section A is an administrative portion of the facility and has no radionuclide or chemical inventory with the exception of exempt sealed sources (used by the Radiological Protection Department to source test equipment). This section has a third floor consisting of office space. Section A was constructed in the early 1950s. Section A is qualified as PC-1.

- Sections B and C consist of radiochemical laboratories and office space on the main floor and radiochemical labs, two Intermediate Level Cells (ILC), administrative spaces, and mechanical and electrical support equipment on the service floor. A sub-basement in each Service Floor contains the majority of the confinement ventilation system exhaust fans. Each section is provided with a dedicated ventilation exhaust stack. Sections B and C contain HC-2 quantities of radionuclides. Sections B and C were constructed in the early 1950s. The building roof, main floor, framing and stack are qualified as PC-3. The balance of the Structures, Systems and Components (SSCs) are qualified as PC-1.

- Section D consists of offices, maintenance shops, chemical and laboratory supply and storage areas, robotics laboratory, glass shop and high bay experimental area. The high bay experimental area still has several pieces of equipment used to develop and test SRS production reactor fuel and target assemblies. A legacy inventory of natural, depleted and enriched uranium is located in the high bay. The sum of fractions for this nuclear material is less than HC-3 quantity. Section D was constructed in the early 1950s with a major addition in the late 1950s. The SSCs are qualified as PC-1.

- Section E contains two High Level Cell (HLC) Blocks A and B as well as the associated support areas (truck bay, high bay, office space, storage space, and shop space) necessary to support operations of the cells. The 16 cells that make up A and B Cell Blocks provide the shielding and confinement necessary for the remote examination, analysis, and testing of highly radioactive materials from onsite and offsite activities. Section E contains HC-2 quantities of radionuclides. Initial construction of Section E was in the early 1950s with major additions in the late 1950s and early 1960s. A major refurbishment of the cells and cell primary confinement ventilation system was completed in the early 1970s. The shielded cells are qualified as PC-3. The balance of the SSCs are qualified as PC-1.

- Section F contains operating laboratories, shielded cell facilities, several "retired" process areas waiting D&D and a high bay experimental area. The shielded cells facilities (for Californium production) are shutdown except for two cells that are used for source transfers between shipping casks and mock-up operations. Section F contains HC-2 quantities of radionuclides. This portion of the building was added in the late 1960s. The SSCs are qualified as PC-1.

- The majority of the air exhausted from Sections E and F and a portion of the air exhausted from Sections B and C discharge to the SRNL Sand Filter (794-A, 792-A and 791-A) for additional filtration before release to the environment. The Sand Filter was added in the early 1970s. The SSCs are qualified as PC-1.

1.2 Confinement Ventilation Systems and Strategy

Confinement Ventilation Systems

The Central Hood Exhaust (CHEX) systems are two independent systems serving Sections B and C with about 30 lab modules in each section. Separate single stage HEPA filter banks serve individual or groups of lab modules. Three of four exhaust fans on-line is the normal operating configuration. Air is discharged to a 75 ft stack for each section of the building. In the event of a loss of power, the system reduces to one exhaust fan provided with standby power. In the event of a significant stack release, the normal exhaust fans can be shutdown and a booster fan (with standby) can be started to "divert" reduced airflow to the SRNL Sand Filter. The booster "diversion" fans are provided with standby power. See Attachment 1 Figures C, D and E.

The Process Hood Exhaust (PHEX) systems are three independent systems serving Sections B, C and F. Each system serves various enclosures, rooms or cells in the respective section of the building. The Section B and C systems have single or double stage HEPA filtration, and redundant exhaust fans. The Section F system has single, double or triple stage HEPA filtration and normally operates two of three exhaust fans. All three systems discharge to the SRNL Sand Filter. All the fans are provided with standby power. See Attachment 1 Figures C, D, E and F.

The Off-Gas Exhaust (OGE) system serves approximately 75 gloveboxes and other special process enclosures equipped with inlet and outlet HEPA filters. Two interconnected OGE sub-systems service Sections B, C and F. Each sub-system has redundant standby two stage HEPA filter housings, redundant exhaust fans and discharges to the SRNL Sand Filter. All the fans are provided with standby power. See Attachment 1, Figures C, G and H.

The B and C Shielded Area Exhaust (RREX) systems exhaust the B and C CHEX and PHEX HEPA filter rooms. There are two independent systems with single stage HEPA filtration and single exhaust fans that discharge to the 75 ft stack located at each section of the building. The fans are not provided with standby power.

The B and C Equipment Room Exhaust (RREX) systems exhaust the sub-basement equipment rooms where the CHEX, OGE and RREX fans are installed. There are two independent systems with single stage HEPA filtration and single exhaust fans that discharge to the 75 ft stack located at each section of the building. The fans are not provided with standby power.

The B and C HVAC Systems provide conditioned air to the offices and corridors (tertiary confinement zone) as well as directly into the labs. The system operates at 1/3 capacity on a loss of normal power or in CHEX Diversion mode (supply air to tertiary confinement zone only). The combined systems consist of thirty 100% outside air units. See Attachment 1, Figures C and D.

The B and C Change/Restroom (HV) exhaust systems are two independent low volume exhaust systems that serve the Men's and Ladies' change rooms. Neither system is HEPA filtered. No standby fans are provided and the fans are not connected to standby power. Each fan discharges to its own stack.

The Cell Exhaust (CE) systems are two independent systems serving the Section E Shielded Cells. Each system has three stages of HEPA filtration, redundant exhaust fans and discharges to the SRNL Sand Filter. All of the fans are provided with standby power. See Attachment 1, Figures I, J and K.

The E Miscellaneous Ventilation Systems, Regulated Room Exhaust – RREX and Local Hood Exhaust – LHEX, consist of six independent exhaust systems that exhaust various rooms in the secondary confinement zone used for loading and unloading cells, surveying samples, storing contaminated equipment and decontaminating equipment removed from the cells. Each system is provided with a single stage of HEPA filtration before discharging to the SRNL Sand Filter. Four systems are equipped with redundant exhaust fans. The other two systems have a normal fan only. One system is connected to standby power. See Attachment 1, Figure I.

The Section E HVAC System consists of two 100% outside air units (serving zones 1 and 3 respectively), one mixed air (partial return) system (serving zones 1 and 2) and two 100% recirculating systems (serving zone 4). None of the systems have redundant fans or standby power. See Attachment 1, Figures I, L and M.

The E Change/Restroom (HV) exhaust systems are two independent low volume exhaust systems. The Men's change room system is provided with HEPA filtration. No standby fans are provided and the fans are not connected to standby power. Each fan discharges to its own stack. See Attachment 1, Figure M.

Section F LHEX System exhausts two chemical labs in the tertiary confinement zone. The system is provided with HEPA filtration and redundant fans connected to standby power. The system discharges to its own stack.

Section F HVAC System consists of two 100% outside air units that are supplied with standby power. Air is supplied to the secondary and tertiary confinement zones. Interlocks between the supply and exhaust systems are provided. See Attachment 1, Figure F.

The Sand Filter (FHSF) system provides an additional stage of filtration before air is discharged to the environment. All primary confinement zone systems in Sections B, C, E and F discharge continuously or can be "diverted" (Section B and C CHEX system) to the Sand Filter. All secondary confinement zone systems in Sections E and F discharge to the Sand Filter. The Sand Filter is equipped with redundant exhaust fans and standby power. See Attachment 1, Figures N and O.

Stack Monitors and Sampling systems are provided for the three primary stacks from 773-A (B Stack, C Stack and Sand Filter Stack). Each stack has both an isokinetic sampling system used for environmental monitoring and a stack monitoring system with on-line alpha and beta/gamma monitors that report to the control room. See Attachment 1, Figure O.

Standby Power is provided by two diesel generators (D/Gs). The 773-A D/G provides standby power to Sections B, C, E and F. The Sand Filter D/G provides standby power to Sections B, C and F.

Confinement Ventilation Strategy

Sections B and C (Attachment 1, Figures C, D, E, G and H)

Primary confinement zones consist of gloveboxes, shielded cells, radiohoods, radiobenches and chemical hoods. Gloveboxes and Section C ILCs are served by the OGE System. Radiohoods, radiobenches, analytical cells and chemical hoods are served by either the CHEX System or the PHEX System. Supply air is transferred from the secondary confinement zones.

Secondary confinement zones consist of lab modules, HEPA filter rooms and equipment rooms. The lab modules are exhausted by the CHEX or PHEX systems. The B/C CHEX and PHEX HEPA filter rooms (B/C-005) are exhausted by the Shielded Area Regulated Room Exhaust (RREX) system. The B/C OGE HEPA filter rooms (B/C-002) are exhausted by the CHEX system. The B/C sub-basement equipment rooms (B/C-001) are exhausted by the Equipment Room RREX systems. The B/C supply air for the lab modules and change/restrooms is split between direct supply and transfer from the tertiary confinement zone. Supply air for HEPA filter rooms is transferred from the tertiary confinement zone.

Tertiary confinement zones consist of offices, change/restrooms, corridors and mechanical/electrical spaces and are supplied air by the HVAC system with the air being transferred to the secondary confinement zones. The change/restrooms are exhausted by independent exhaust (HV) systems.

Section E (Attachment 1, Figures I, J. K, L, M)

Primary confinement zones consist of the two cell blocks (A and B), as well as two manipulator repair gloveboxes. These areas are served by the two independent CE systems. Supply air is transferred from the secondary confinement zone.

Secondary confinement zones consist of the cell large equipment loading area (high bay), cell small equipment loading areas (transfer ports), manipulator glovebox room and cell operating areas. These areas have a limited quantity of direct supply air with the overwhelming majority being transferred from the tertiary confinement zone. These areas have a number of direct exhaust systems for locations with a higher contamination potential.

Tertiary confinement zones consist of office, change/restrooms, storage, maintenance and support spaces surrounding the secondary confinement zone. The spaces have a mixture of recirculating HVAC systems, 100% outside air HVAC systems and unfiltered exhaust systems. The men's and women's change rooms are directly exhausted to the environment.

Section F (Attachment 1, Figure F)

Primary confinement zones consist of two cell blocks (Medical Source Facility and Californium Processing Facility), gloveboxes and radiohoods. The cells, radiohoods and some gloveboxes are exhausted by the PHEX system. The remaining gloveboxes are exhausted by the OGE system. Supply air is transferred from the secondary confinement zones.

Secondary confinement zones consist of the lab modules, process rooms or experimental high bay. Direct exhaust to the PHEX system is provided in the process rooms and high bay. Direct supply air is provided in the lab modules. Transfer supply air is provided from the tertiary confinement zones for the process rooms and high bay.

Tertiary confinement zones consist of the operating areas, service galleries, office space and two non-radiological lab modules. With the exception of the two lab modules, air is supplied to the spaces and then is transferred to the secondary confinement zones. For the two lab modules, air is exhausted through fume hoods by a HEPA filtered exhaust system.

1.3 Major Modifications

There are currently no major modifications or anticipated mission changes for Building 773-A.

2.0 Functional Classification Assessment

2.1 Existing Classification

The confinement ventilation systems for SRNL Building 773-A are not credited in the design basis accident analyses for providing radiological dose reduction for the offsite and onsite receptors. Therefore, the mitigated and unmitigated dose to the Maximally Exposed Offsite Individual (MOI) and Co-located Worker (CW) are the same. However, some of the confinement ventilation systems for Building 773-A are functionally classified as Safety Significant to protect in-facility workers from potential radiological hazards from explosion events involving accumulation of process or distributed flammable gas. Table 4-3 (Attachment 2) provides a discussion of the DSA identified design basis events within the facility. The balance of the ventilation and support systems are functionally classified as General Services.

2.2 Evaluation

The DSA Hazard and Accident Analyses did not identify any Design Basis Accidents that challenge the Evaluation Guidelines for the Offsite Public or Co-located Worker as defined in the WSRC Consolidated Hazard Analysis Manual (Reference A). All the events are in the Low or Negligible Consequence regions (Attachment 3). The bounding NPH event doses are 1.9 rem to the MOI and 8.1 rem to the CW (50% meteorology). The bounding Process Event doses are 2.2 rem to the MOI and 10.8 rem to the CW. All these events assume a Leak Path Factor of 1.0.

The DSA credits several systems as Safety Significant for the Facility Worker based on qualitative analysis. These functions are detailed in Attachment 2 (Table 4-3).

2.3 Summary

The SS functional classification of several confinement ventilation systems for protection of the facility worker and GS functional classification of the balance of the confinement ventilation systems are appropriate.

3.0 System Evaluation

Using the Table 4-3 Evaluation Criteria, six events were identified that exceed the 1 rem criteria for the MOI. No events were identified that exceed the 100 rem criteria for the CW. This includes considering the impact of changing from 50% to 95% meteorological conditions for the CW analysis which was assumed to cause a five fold increase in the CW unmitigated consequences. The six events are listed below in Table 1a.

Table 1a – DSA Events Greater than DNFSB 2004-2 Evaluation Criteria

	Event	Section Applicability	Unmitigated Consequences
1	Explosion – Glovebox Overpressurization	B, C and F	CW 9.6 rem (1) MOI 1.9 rem
2	Process Explosion – Unstable Lab Chemical or Accumulation of Process Flammable Gas or VOCs with consequential fire	B, C, E and F	CW 10.5 rem (1) MOI 2.2 rem
3	Explosion – Accumulation of Distributed Flammable Gas with consequential fire	B, C and F	CW 10.8 rem (1) MOI 2.2 rem
4	Earthquake with consequential fire -- Unstable Lab Chemical or Accumulation of Process Flammable Gas or VOCs with no consequential fire	B, C, E and F	CW 8.1 rem (1) MOI 1.6 rem
5	Tornado/High Winds with no consequential fire	B, C, E and F	CW 2.7 rem (1) MOI 1.1 rem
6	Tornado/High Winds with consequential fire	B, C, E and F	CW 6.6 rem (1) MOI 1.9 rem

(1) - Based on 50% Meteorology

Of those six events than exceed the 1 rem MOI evaluation criteria, five (2 thru 6) involve an NPH initiator or a Full Facility fire. These five events along with the six Table 5-1 evaluation criteria associated with fire and NPH events were excluded from further analysis based on guidance provided in References B and C. For additional information, see Attachment 4.

After exclusion of NPH and Full Facility Fire events, only one event (glovebox overpressurization) passed the screening criteria for Table 5-1 evaluation. However, to develop a more complete understanding of the hazards that can be mitigated by an active confinement ventilation system, the Facility Evaluation Team (FET) elected to include four additional events from the original hazards analysis (Reference D) for evaluation during preparation of the Table 5-1 Evaluation. These five events to be evaluated are listed below as Table 1b.

Table 1b - Events to be evaluated as Part of Table 5-1/System Evaluation

	Event	Section Applicability	Unmitigated Consequences (2)
1	Explosion – Glovebox Overpressurization	B, C and F	CW 9.6 rem (1) MOI 1.9 rem
2	Explosion – Accumulation of Distributed Flammable Gas with no consequential fire	B, C and F	CW 8.57 rem (1) MOI 1.68 rem
3	Drop / Spill	B, C, E and F	CW 1.5 rem (1) MOI 0.31 rem
4	Process Explosion – Unstable Lab Chemical or Accumulation of Process Flammable Gas or VOCs with no consequential fire	E	CW 1.5 rem (1) MOI 0.31 rem
5	Process Explosion – Unstable Lab Chemical or Accumulation of Process Flammable Gas or VOCs with no consequential fire	B, C and F	CW 1.1 rem (1) MOI 0.21 rem

(1) – Based on 50% Meteorology
(2) – Reference D

The accident analyses for the events in Tables 1a and 1b assumed a Leak Path Factor of 1.0 and assumed no mitigation from the Safety Significant active confinement ventilation systems that protect the facility worker.

As presented in the Table 4-3 report (Reference E), the ventilation systems in two sections of 773-A (A and D) as well four low capacity ventilation systems in Sections B and C were excluded from further analysis. Attachment 5, extracted from the Table 4-3 report, provides additional details and basis for excluding these systems/sections from further evaluation.

3.1 GAP Identification

Using the Safety Class (SC) performance criteria in the evaluation guidance (References B and F), the FET performed a functional review of 15 ventilation systems (773-A B/C-CHEX, B/C-PHEX, B/C-HVAC, B/C-RREX, B/C-HV, B/C/F-OGE, E-CE, E-HVAC, E-RREX, E-LHEX, E-HV, F-PHEX, F-HVAC, F-LHEX, and FHSF) serving four of six sections of Building 773-A. Since the SC performance criteria are used, the evaluation and identification of any associated gaps would not change if meteorological conditions were changed from 50% to 95% for the CW.

As discussed above, five process events were used as the basis of the evaluation and the six evaluation criteria for fire and NPH events were not included since 773-A is an existing facility. Based on the Low or Negligible consequence (Reference A and Attachment 3) of all the events, no evaluation criteria or attributes were considered mandatory by the Site Evaluation Team (SET) or FET.

A cross-cut matrix (Table 2) of the 58 identified gaps by system and criteria is provided on the following pages. A detailed list of the gaps is provided as Attachment 6. The basis for each gap is provided in Attachment 7 (Table 5-1 Work Sheets).

The FET has grouped and split the gaps across systems and criteria based on the following considerations:

In some cases, gaps have been combined across system boundaries where closure of the same criteria for multiple systems would need to be executed together to have the desired outcome. An example is the interlocks between the supply and exhaust systems in Section E, which cross four systems boundaries: E-HVAC, E-CE, E-RREX and E-LHEX.

In other cases, the same gap across multiple system boundaries has been evaluated separately since the priority for closing a gap may be different based on the consequence and likelihood of a specific event in a specific location. An example is that the B/C-CHEX systems serve 59 lab modules with the potential for events 1, 2, 3 and 5 to occur while the B/C-PHEX systems serve 5 labs with the potential for events 1, 3 and 5 and the F PHEX system serves 2 labs with the potential for events 1, 3 and 5. Therefore, the priority for closing any gaps associated with the B/C-CHEX system would have a higher priority to close than gaps only associated with the B/C-PHEX or F-PHEX systems.

Table 2
Page 1 of 2

Cross-Cut Matrix Identifying Gaps by Table 5.1 Evaluation Criteria
Building 773-A Ventilation Systems

System & Evaluation Criteria	B&C-CHEX	B&C-PHEX	B/C/F-OGE	B&C-RREX	B&C-HVAC	B&C-HV	E-CE	E-RREX	E-HVAC	E-LHEX	E-HV	F-PHEX	F-LHEX	F-HVAC	FHSF
1.1	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
1.2	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
1.3	1	✔	✔	✔	2	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
1.4	✔	✔	✔	✔	✔	8	23, 24	39	33	35	28	✔	✔	✔	✔
2.1	✔	✔	19, 20	✔	13, 14	9	25	40, 41	34	✔	29	50-52	45, 46	✔	✔
2.2	3	3	✔	16	3	✔	26	26	26	26	✔	✔	✔	✔	✔
2.3	✔	✔	✔	✔	✔	10	✔	✔	✔	✔	30	✔	47	✔	✔
2.4	✔	✔	✔	✔	13	9	✔	✔	✔	✔	✔	✔	✔	✔	✔
2.5	✔	✔	21	✔	2	✔	✔	✔	✔	✔	✔	53	✔	✔	✔
3.1	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
3.2	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
4.1	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔

✔ - No Gap   # – Gap Number

Table 2
Page 2 of 2

Cross-Cut Matrix Identifying Gaps by Table 5.1 Evaluation Criteria
Building 773-A Ventilation Systems

System & Evaluation Criteria	B&C-CHEX	B&C-PHEX	B/C/F-OGE	B&C-RREX	B&C-HVAC	B&C-HV	E-CE	E-RREX	E-HVAC	E-LHEX	E-HV	F-PHEX	F-LHEX	F-HVAC	FHSF
5.1	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
5.2	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
6.1	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
7.1	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
8.1	4,5	4	✔	✔	✔	✔	✔	42	✔	36	✔	54	✔	✔	✔
8.2	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
8.3	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
9.1	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
10.1	6,7	15	21, 22	17	✔	11	27, 58	43	✔	37	31	55	48, 49	✔	56
10.2	✔	✔	✔	18	✔	12	✔	44	✔	38	32	✔	✔	✔	57
10.3	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
11.1	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔

✔ - No Gap # -- Gap Number

3.2 GAP Evaluations

Since 773-A is already provided with General Services active confinement ventilation systems that would provide some mitigation for the evaluated process events, the FET considered the following criteria when evaluating the 58 gaps for closure:

- Does the gap identify a discrepancy between the DSA and field conditions?
- Is the gap associated with a primary, secondary or tertiary confinement system?
- Could closing the gap decrease the probability of an event from occurring?
- Could closing the gap provide the ability to mitigate an event from Low to Negligible consequence level? (Reference A and Attachment 3)
- Would closing an alternative gap provide the same or better mitigation of an event at a lower cost?
- Is the process in the primary confinement zone active or shutdown (Reference G Page 2.5-29 thru 2.5-33)?
- The number of active process areas affected by the gap (see last paragraph of Section 3.1)

The recommendation and priority to close individual gaps is summarized in Table 3. Discussion of each individual gap recommendation is provided in Attachment 8. A cross-walk of gaps recommended for closure which reduce the potential or mitigate the consequence of the five evaluated process events is provided in Attachment 9. A summary of Table 3 is as follows:

- Overall 24 of 58 gaps are recommended to be closed.
- No gaps are identified that constituted a discrepancy between the DSA and field conditions.
- 23 gaps are related to a primary confinement zone. Of these gaps, 15 are recommended to be closed (Gaps 1, 4, 5, 6, 15, 20, 21, 22, 23, 24, 27, 53, 55, 56 and 58 for systems B/C-CHEX, B/C-PHEX, B/C/F-OGE, E-CE, F-PHEX and FHSF).
- 25 gaps are related to a secondary confinement zone. Of these gaps, 14 are recommended to be closed (Gaps 3, 4, 6, 15, 26, 35, 36, 37, 38, 39, 40, 42, 55 and 56 for systems B/C-CHEX, B/C-PHEX, B/C-HVAC, E-RREX, E-LHEX, F-PHEX, F-HVAC and FHSF).
- 31 gaps are related to a tertiary confinement zone. Of these gaps, 12 are recommended to be closed (Gaps 3, 6, 26, 35, 36, 37, 38, 39, 40, 42, 55 and 56 for systems B/C-CHEX, B/C-PHEX, B/C-HVAC, E-RREX, E-LHEX, F-PHEX and FHSF).

- 8 gaps could decrease the probability (prevent) of the Low consequence events to Negligible. Of these gaps, 7 are recommended to be closed (Gaps 6, 20, 21, 22, 53, 55 and 56).

- 9 gaps could decrease the probability (prevent) of a Negligible consequence event. Of these gaps, all 9 are recommended to be closed (Gaps 6, 15, 20, 21, 22, 27, 53, 56 and 58 for systems B/C-CHEX, B/C-PHEX, B/C-OGE, E-CE, F-PHEX and FHSF).

- 8 gaps could increase the ability of the existing system to mitigate of a Low consequence event to Negligible. Of these gaps, 7 are recommended to be closed (Gaps 3, 4, 6, 15, 53, 55 and 56 for systems B/C-CHEX, B/C-HVAC, B/C-PHEX, F-PHEX and FHSF).

- 36 gaps could increase the ability of the existing system to mitigate a Negligible consequence event. Of these gaps, 18 are recommended to be closed (Gaps 1, 3, 4, 5, 6, 15, 26, 27, 35, 36, 37, 38, 39, 42, 53, 55. 56 and 58 for systems B/C-CHEX, B/C-HVAC, B/C-PHEX, E-CE, E-RREX, E-LHEX, F-PHEX and FHSF).

- 16 gaps are not recommended for closure based upon the FET's evaluation that closure of an alternative gap would also mitigate this gap. (Gaps 2, 7, 8, 9, 10, 11, 12, 13, 14, 19, 28, 29, 30, 31, 32 and 33)

- 3 of the gaps identified dealt with inactive facilities. None of these gaps are recommended to be closed. (Gaps 50, 51 and 54)

Table 3
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Gap Recommendations and Closure Priority

Gap No.	Confinement Zone			Event Criteria				Recommend Close Gap	Priority to Close Gap
	Primary	Secondary	Tertiary	A	B	C	D		
1	x						x	Y	Low
2		x	x				x	N	
3		x	x			x	x	Y	High
4	x	x				x	x	Y	High
5	x						x	Y	Low
6	x	x	x	x	x	x	x	Y	High
7	x	x				x	x	N	
8			x				x	N	
9			x				x	N	
10			x				x	N	
11			x				x	N	
12			x				x	N	
13		x	x					N	
14			x				x	N	
15	x	x			x	x	x	Y	Low
16		x					x	N	
17		x					x	N	
18		x					x	N	
19	x							N	
20	x			x	x			Y	Low
21	x			x	x			Y	Low
22	x			x	x			Y	Low
23	x							Y	Low
24	x							Y	Low
25	x							N	
26		x	x				x	Y	Low
27	x				x		x	Y	Low
28			x				x	N	
29			x				x	N	

A – Potential to prevent Low consequence event if gap is closed
B – Potential to prevent Negligible consequence event if gap is closed
C – Potential to mitigate Low consequence event if gap is closed
D – Potential to mitigate Negligible consequence event if gap is closed

High – Closes a gap with potential MOI dose greater than 1 rem (Low consequence) that the FET feels will provide a significant improvement in the performance of the confinement ventilation systems.

Medium – Closes a gap with a potential negligible MOI dose that the FET feels will provide a significant improvement in the performance of the confinement ventilation systems.

Low – Closes a gap that the FET feels will provide a meaningful improvement in the performance of the confinement ventilation systems.

Table 3
Page 2 of 2

Gap Recommendations and Closure Priority

Gap No.	Confinement Zone			Event Criteria				Recommend Close Gap	Priority to Close Gap
	Primary	Secondary	Tertiary	A	B	C	D		
30			x				x	N	
31			x				x	N	
32			x				x	N	
33		x					x	N	
34		x	x					N	
35		x					x	Y	Medium
36		x					x	Y	Medium
37		x					x	Y	Medium
38		x					x	Y	Medium
39		x					x	Y	Low
40		x					x	Y	Medium
41		x						N	
42		x					x	Y	Medium
43		x						N	
44		x						N	
45			x					N	
46			x					N	
47			x					N	
48			x					N	
49			x					N	
50	x			x				N	
51	x							N	
52	x							N	
53	x	x		x	x	x	x	Y	Low
54	x						x	N	
55	x	x	x	x		x	x	Y	Low
56	x	x	x	x	x	x	x	Y	Low
57	x							N	
58	x				x		x	Y	Medium

A – Potential to prevent Low consequence event if gap is closed
B – Potential to prevent Negligible consequence event if gap is closed
C – Potential to mitigate Low consequence event if gap is closed
D – Potential to mitigate Negligible consequence event if gap is closed

High – Closes a gap with potential MOI dose greater than 1 rem (Low consequence) that the FET feels will provide a significant improvement in the performance of the confinement ventilation systems.

Medium – Closes a gap with a potential negligible MOI dose that the FET feels will provide a significant improvement in the performance of the confinement ventilation systems.

Low – Closes a gap that the FET feels will provide a meaningful improvement in the performance of the confinement ventilation systems.

3.3 Modifications and Upgrades

Scopes and estimates were developed for the closure of the identified gaps. The process was simplified by grouping similar gaps together and developing parametric estimates when appropriate. The estimates developed are Total Project Cost (TPC) in FY07 dollars. They include both the Total Estimated Cost (TEC) and Other Project Cost (OPC)/Operating Expense (OPEX) to complete closing the gap. The majority of the estimates are Rough Order of Magnitude (Class 4 and 5 Estimates). Some gaps had been previously identified by the facility to improve operational safety and have more detailed project definition. These estimates are provided with a tighter estimate range than typical of a Class 4 or 5 Estimate. For some gaps, several alternatives were considered for closing the gap. Discussion is provided as appropriate to justify why an alternative closure was selected.

The duration to close all the gaps is estimated to be between 8 and 10 years. The duration to close the recommended gaps is estimated to be between 4 and 6 years, contingent upon funding. Closure of individual gaps varies in duration from 2 months to 4 years. Total duration is driven by the need to maintain laboratory operations, i.e. certain gap closure activities can not be performed concurrently without placing the overall facility confinement strategy/air balance at risk.

The cost range to close all the gaps is between $37M and $107M depending upon the gap closure method selected. The cost range to close the recommended gaps using the method recommended is between $23M and $33M. A cost estimate summary is provided as Table 4 at the end of this section.

Discussion of individual gaps including closure scope(s), estimate range and recommendation (Close/Not Close and Alternatives to Close Gap) is provided in Attachment 8. The task number in the estimate range section provides a link to the background file for each task.

Table 4
High/Low Gap Estimates ($K)

Gap Number	All Gaps and Alternative		Recommended Gaps and Selected Alternatives	
	Low	High	Low	High
1	190	290	190	290
2	3,200	5,100	0	0
3	3,900	5,700	3,900	5,700
4	10,000	57,000	10,000	15,000*
5 (see Gap #1)	0	0	0	0
6	150	250	150	250
7	1,200	1,800	0	0
8	600	5,200	0	0
9 (see Gap #8)	0	0	0	0
10 (see Gap #8)	0	0	0	0
11 (see Gap #8)	0	0	0	0
12 (see Gap #8)	0	0	0	0
13	1,200	1,700	0	0
14	130	185	0	0
15	150	250	150	250
16	300	600	0	0
17	2,000	3,200	0	0
18	300	500	0	0
19	420	630	0	0
20	3,400	4,300	3,400	4,300
21	100	200	100	200
22	150	250	150	250
23	2	30	2	4*
24	2	35	2	4*
25	160	240	0	0
26	600	1,000	600	1,000
27	830	1,200	830	1,200
28	300	5,200	0	0
29 (see Gap #28)	0	0	0	0
30 (see Gap #28)	0	0	0	0
31 (see Gap #28)	0	0	0	0
32 (see Gap #28)	0	0	0	0
33	215	320	0	0
34	600	1000	0	0
35	2000	2300	2000	2300
36 (see Gap #35)	0	0	0	0
37 (see Gap #35)	0	0	0	0
38	75	250	75	250
39 (see Gap #35)	0	0	0	0
40 (see Gap #35)	0	0	0	0
41	250	300	0	0
42 (see Gap #35)	0	0	0	0
43	350	500	0	0
44	150	300	0	0
45	20	30	0	0
46	100	200	0	0
47	90	1,500	0	0
48	600	1,000	0	0
49	150	250	0	0
50	35	65	0	0
51	80	120	0	0
52	740	1100	0	0
53	70	110	70	110
54	180	240	0	0
55	75	125	75	125
56	650	1,300	650	1,300
57	500	750	0	0
58	390	550	390	550
Total	36,604	107,170	22,734	33,083

* - Gap Closure Estimate where lower cost alternative was selected (See Section 3.3 first and last paragraph)

4.0 Conclusion

The evaluation identified that there are no gaps that require immediate attention. All 58 gaps were found to be discretionary in nature since none of the gaps involved a discrepancy between the DSA requirements and the facility design.

In reviewing the discretionary gaps, closure of a number of gaps (24) would be necessary to credit the key existing primary and secondary confinement ventilation systems as Safety Class or Safety Significant for protection of the MOI or CW. Closure of these gaps would provide a discernable improvement in the reliability and effectiveness of the existing integrated active confinement ventilation system for protection of the facility worker.

Based on the original Recommendation 2004-2 discussion, the FET recommends that Gaps 3, 4, and 6 be closed in the near term to provide a Safety Significant primary confinement ventilation system for 773-A Sections B and C. These two sections of the building are the most likely location for a process event with an MOI potential dose greater than 1 rem. The cost range in FY07 dollars to close these three gaps is between $14M and $21M. The schedule duration, if funded as a single project, is between 36 and 42 months. If funded as currently forecast in the SRNL Infrastructure Plan, the work would be completed no sooner than 2017.

Based on the feedback from the IRP and DNFSB during the ARP Pilot, the FET recommends that the following 7 gaps be closed, at the Functional Classification level of Safety Significant, in the near term as incremental improvements to the performance of the confinement ventilation systems in 773-A Section E:

- Close Gaps 35, 36, 37, 38, 40 and 42 to increase the performance and reliability of the Secondary Confinement Zone Ventilation Systems that support loading and unloading the shielded cells. The cost range in FY07 dollars to close these gaps is between $1.5M and $2.0M. The schedule duration is between 18 and 24 months. Design for this project is already 70% complete and engineered material has been purchased. Funding is needed to complete the design, construction and start-up phases.

- Close Gap 58 to increase the reliability of the Primary Confinement Zone Ventilation System in Section E for the shielded cells. The cost range in FY07 dollars to close this gap is between $390K and $500K. The schedule duration is between 12 and 18 months. Design for this project is already complete.

Based on the enduring mission of SRNL in Building 773-A, the FET recommends that the following 14 gaps be closed, at the Functional Classification level of Safety Significant, over the long term to provide incremental improvements to the performance of the confinement ventilation systems in 773-A:

- For events with an MOI potential dose greater than or equal to 1 rem, the FET recommends closing Gaps 15, 20, 21, 22, 53, 55 and 56 associated with the primary confinement systems in 773-A Sections B, C and F. The cost range in FY07 dollars to close these gaps is $4.6M to $6.5M.

- For events with an MOI potential dose less than 1 rem, the FET recommends closing Gaps 23, 24, 26, 27 and 39 associated with the primary and secondary confinement systems in 773-A Section E and Gaps 1 and 5 associated with the 773-A Section B/C CHEX. The cost range in FY07 dollars to close these gaps is $1.5M to $3.0M.

5.0 References

A) WSRC-SCD-11, Consolidated Hazard Analysis Process Program & Methods, Table 7-2 Consequence Evaluation Level for Hazard Receptors, Rev. 5, April 15, 2007

B) Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Rev. 0, January 2006

C) 2004-2 Ventilation System Evaluation Guidance Addendum, March 7, 2007

D) S-CLC-A-00130, Updated Source Term and Radiation Dose Calculation to Support SRNL Safety Basis Documentation, Rev. 0, June 2006

E) SRNL-ROE-2007-00063, Savannah River National Laboratory Building 773-A, DNFSB 2004-2 Active Confinement Ventilation System Evaluation Table 4-3, April 23, 2007

F) D. Y. Chung to J. M. Allison, Request for Concurrence with Recommendation of the Defense Nuclear Facility Safety Board (DNFSB) 2004-2 Table 4.3 Data Collection for the Savannah River National Laboratory (SRNL), June 19, 2007

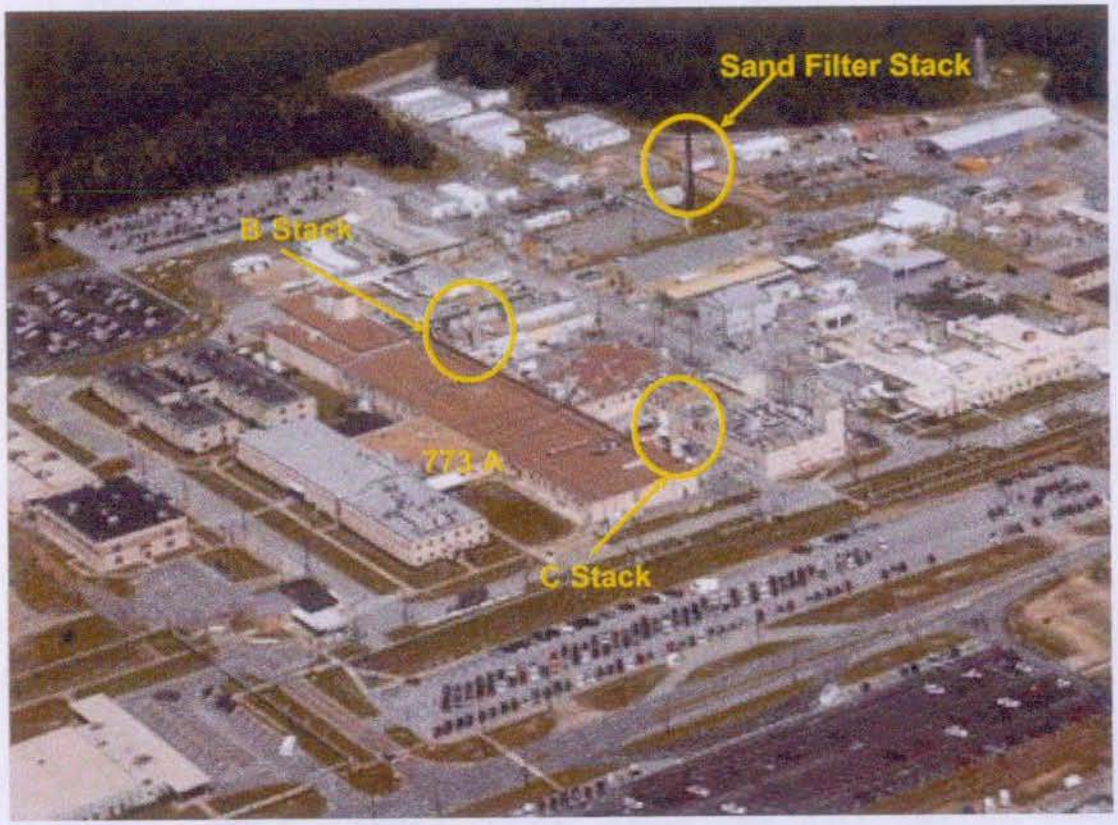
G) WSRC-SA-2, SRNL Technical Area Documented Safety Analysis (DSA), Rev. 3, February 2007

H) SRNL-ROE-2007-00093, DNFSB 2004-2 Table 5-1 Submittal for Savannah River National Laboratory (SRNL) Building 773-A, Sections B&C Ventilation and Off-Gas Exhaust (OGE) Systems, June 27, 2007

I) SRNL-ROE-2007-00115, DNFSB 2004-2 Table 5-1 Submittal for Savannah River National Laboratory (SRNL) Building 773-A Section E & F Ventilation and Sand Filter Systems, July 25, 2007

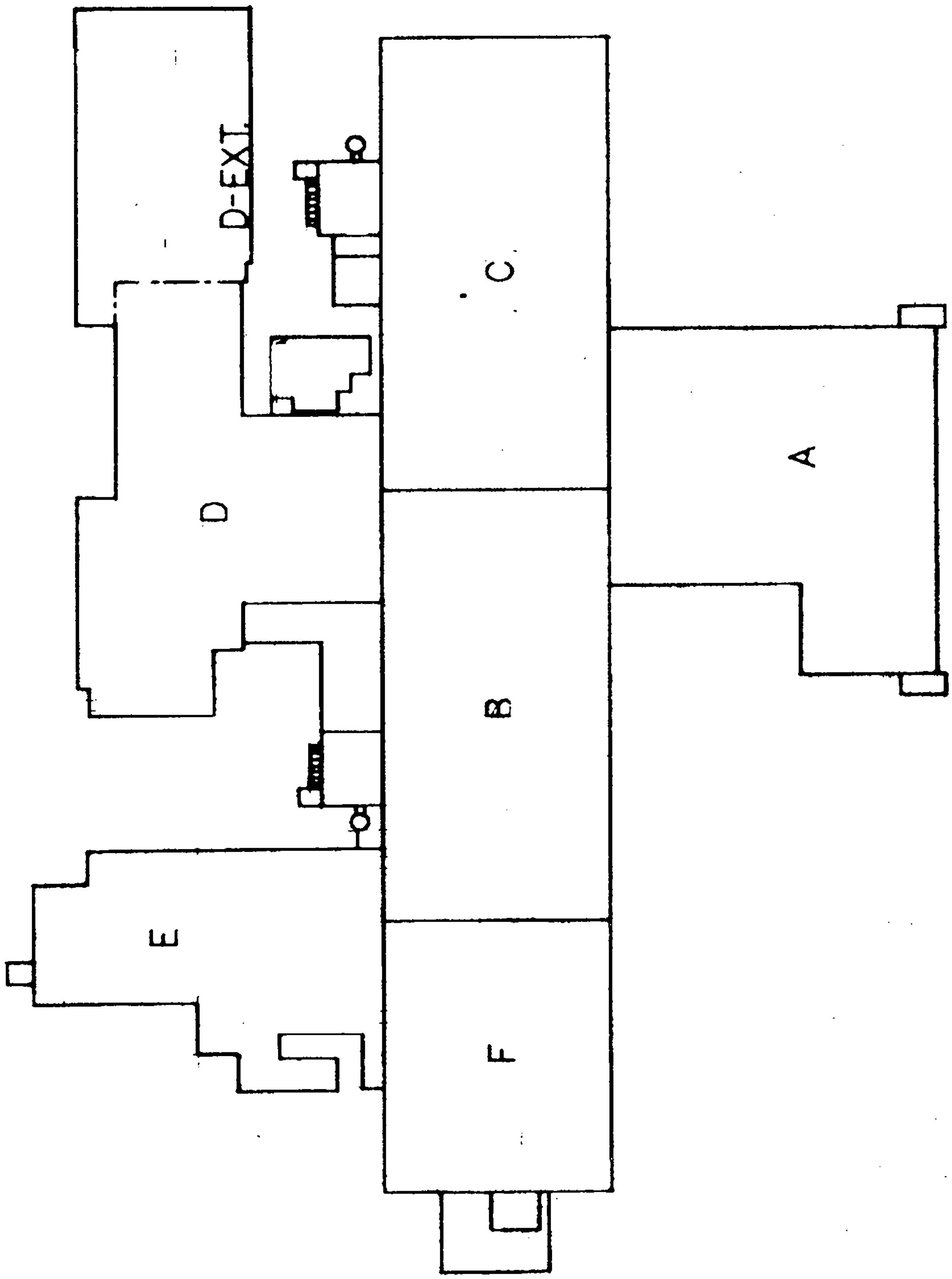
J) WSRC-TS-97-0014, SRNL Technical Area Technical Safety Requirements, Rev. 4, February 2007

Attachment 1 – List of Figures



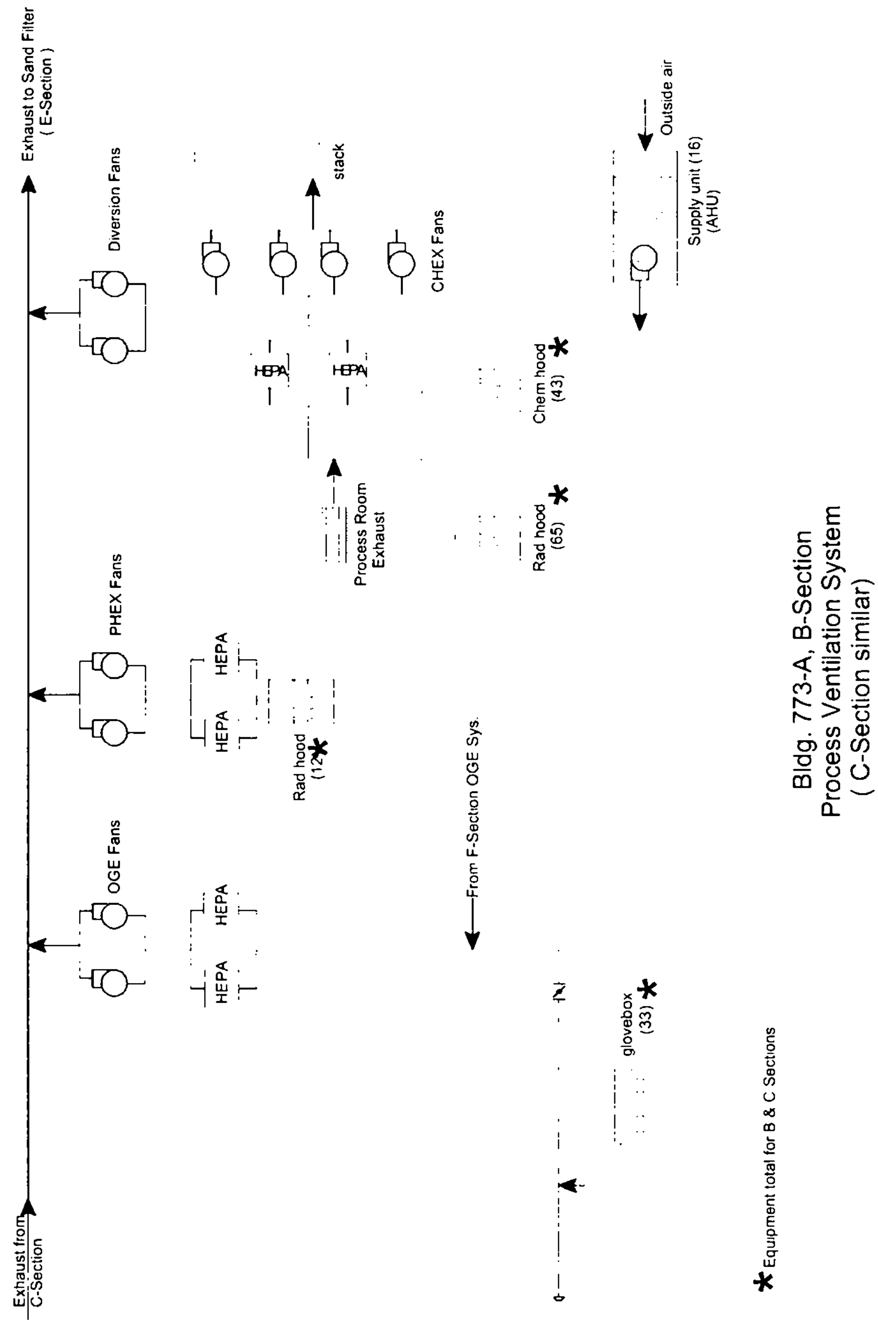
Attachment 1 - Figure A

Picture of SRNL Technical Area



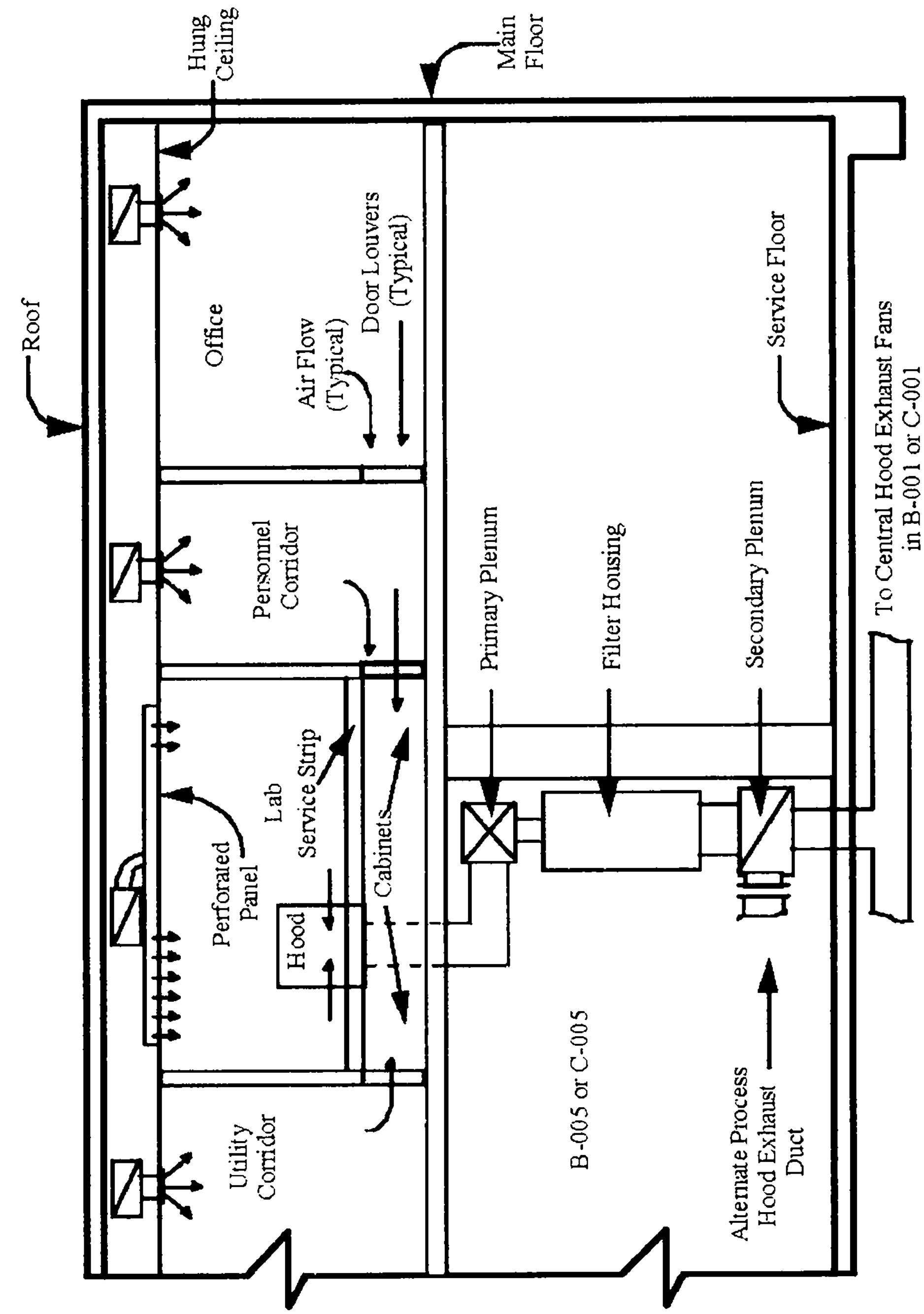
Attachment 1 – Figure B

Building 773-A, SRNL Main Laboratory Floor Plan



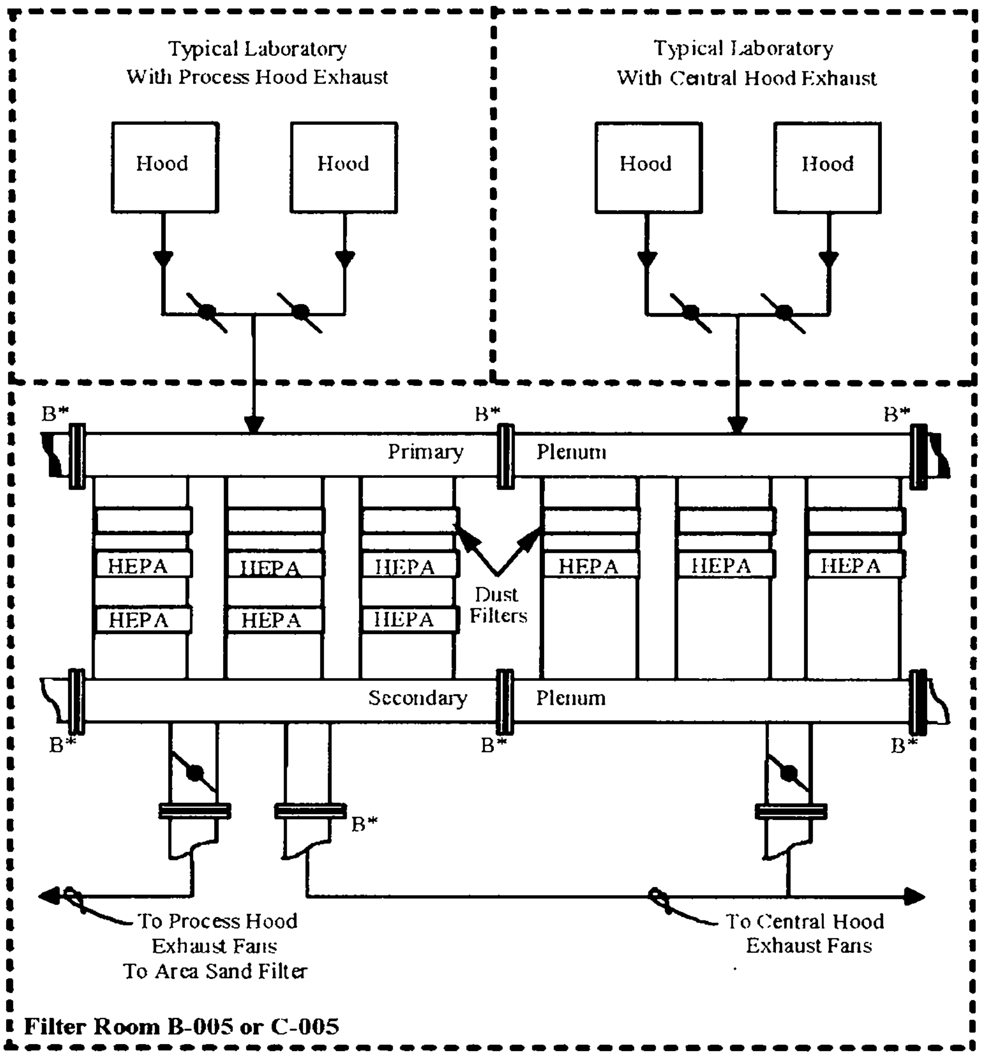
Attachment 1 - Figure C

Building 773-A Process Ventilation System



Attachment 1 - Figure D

Building 773-A General Schematic Air Flow Patterns – Sections B and C

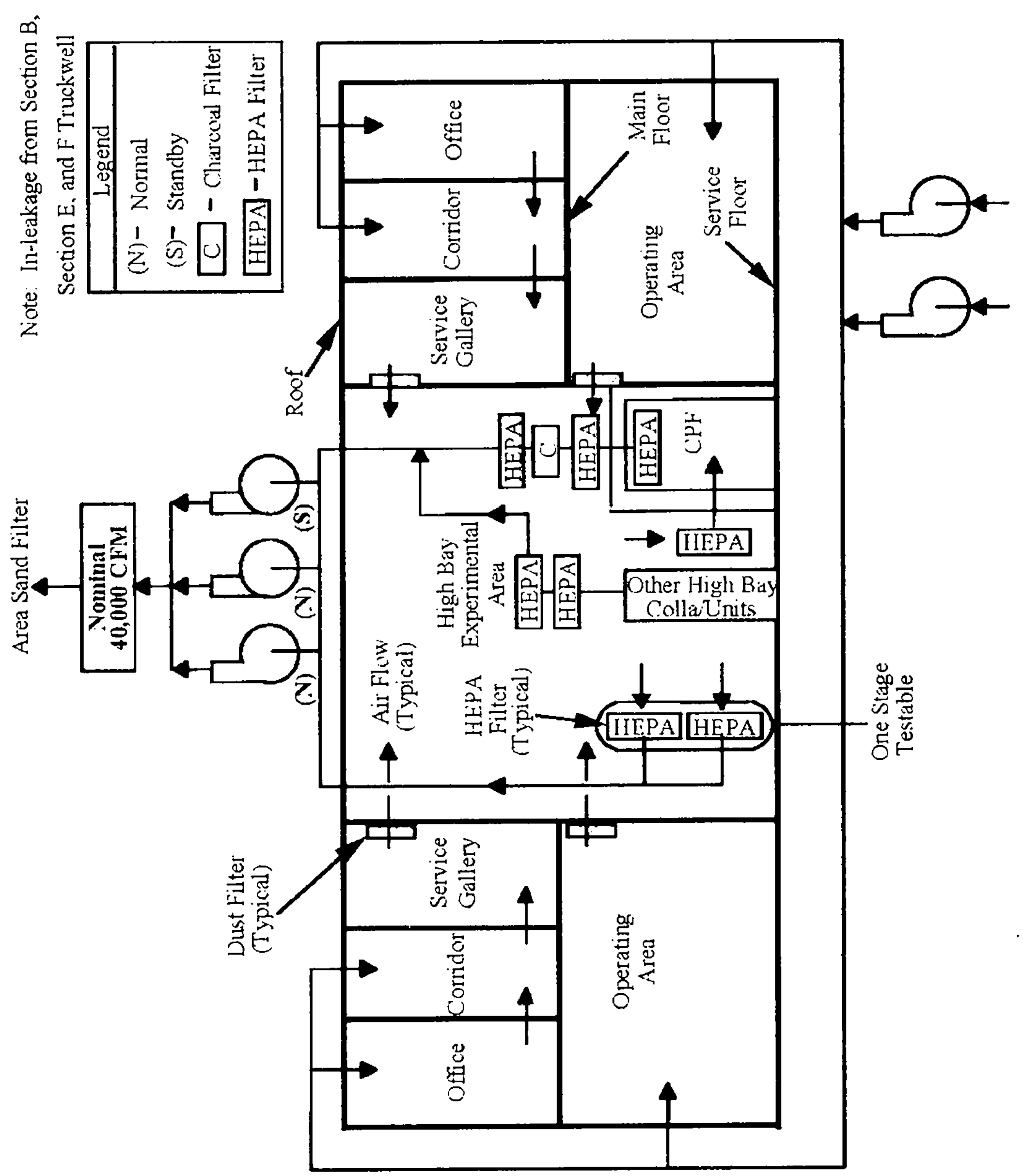


B* - Flange with Blank Plate

Note that blanks isolate the process hood exhaust system from the central hood exhaust system.

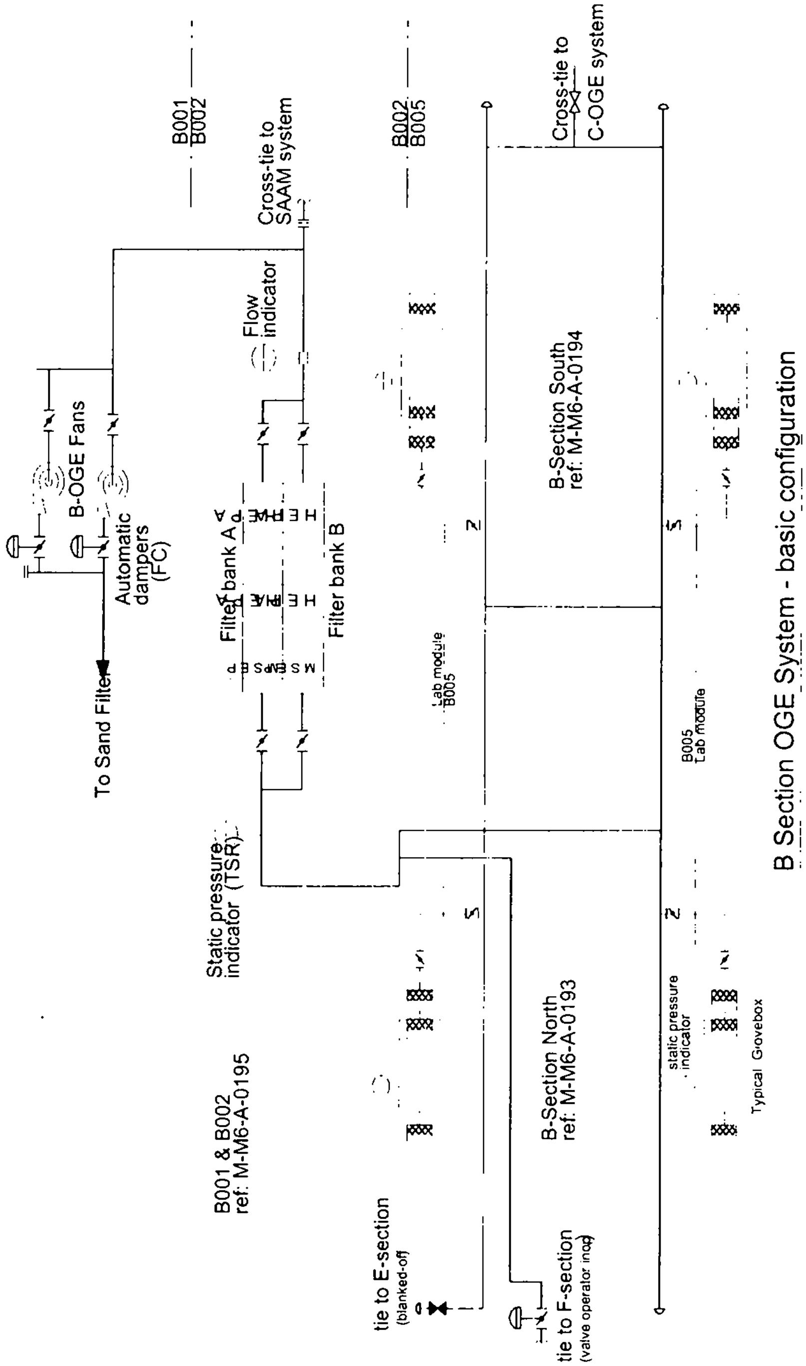
Attachment 1 - Figure E

Typical Section B and C CHEX and PHEX Hood and Exhaust Filter Arrangement



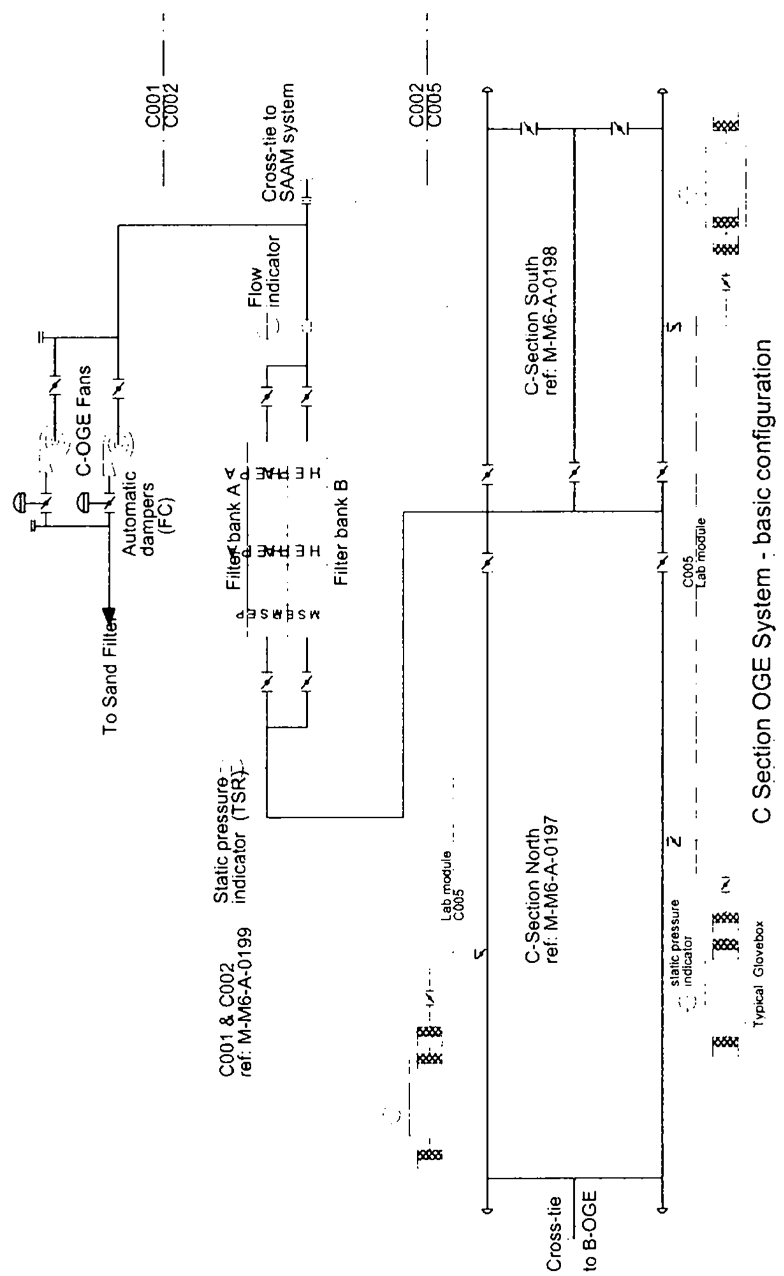
Attachment 1 - Figure F

Building 773-A Ventilation Diagram - Section F



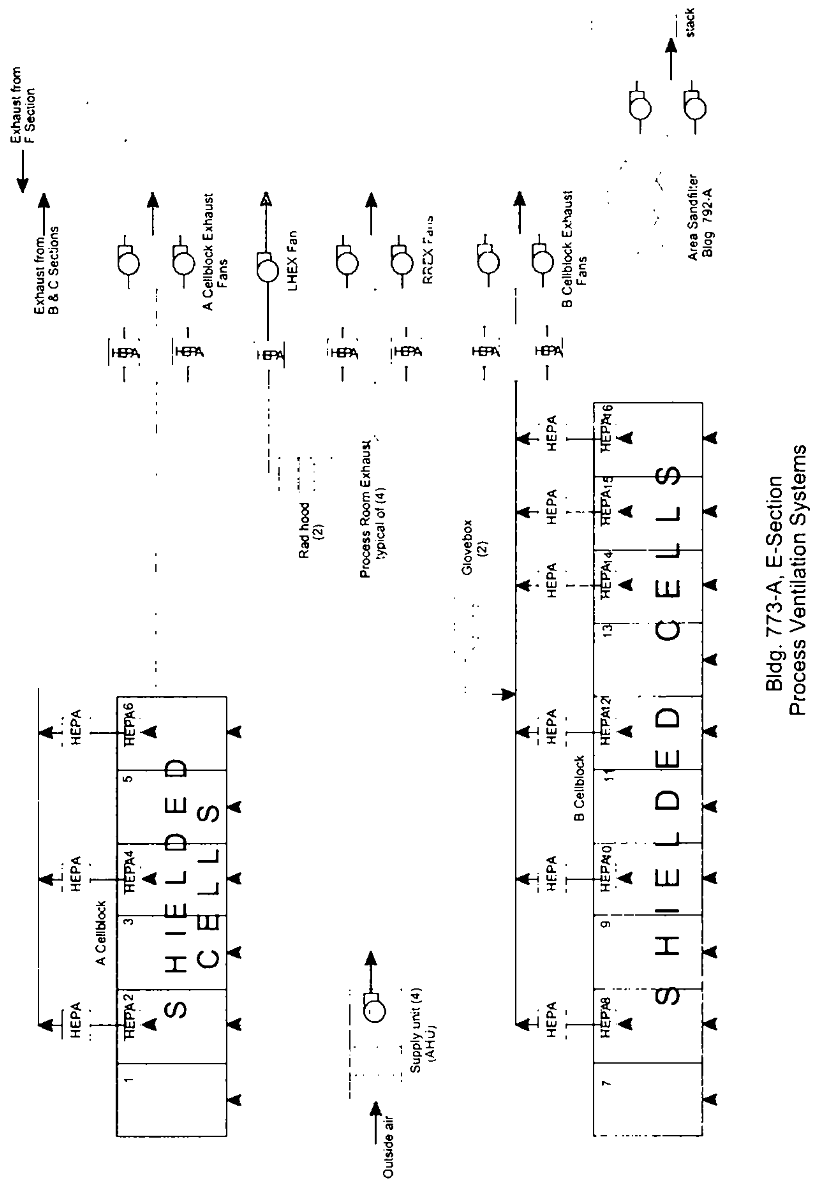
Attachment 1 - Figure G

B Section OGE System - Basic Configuration



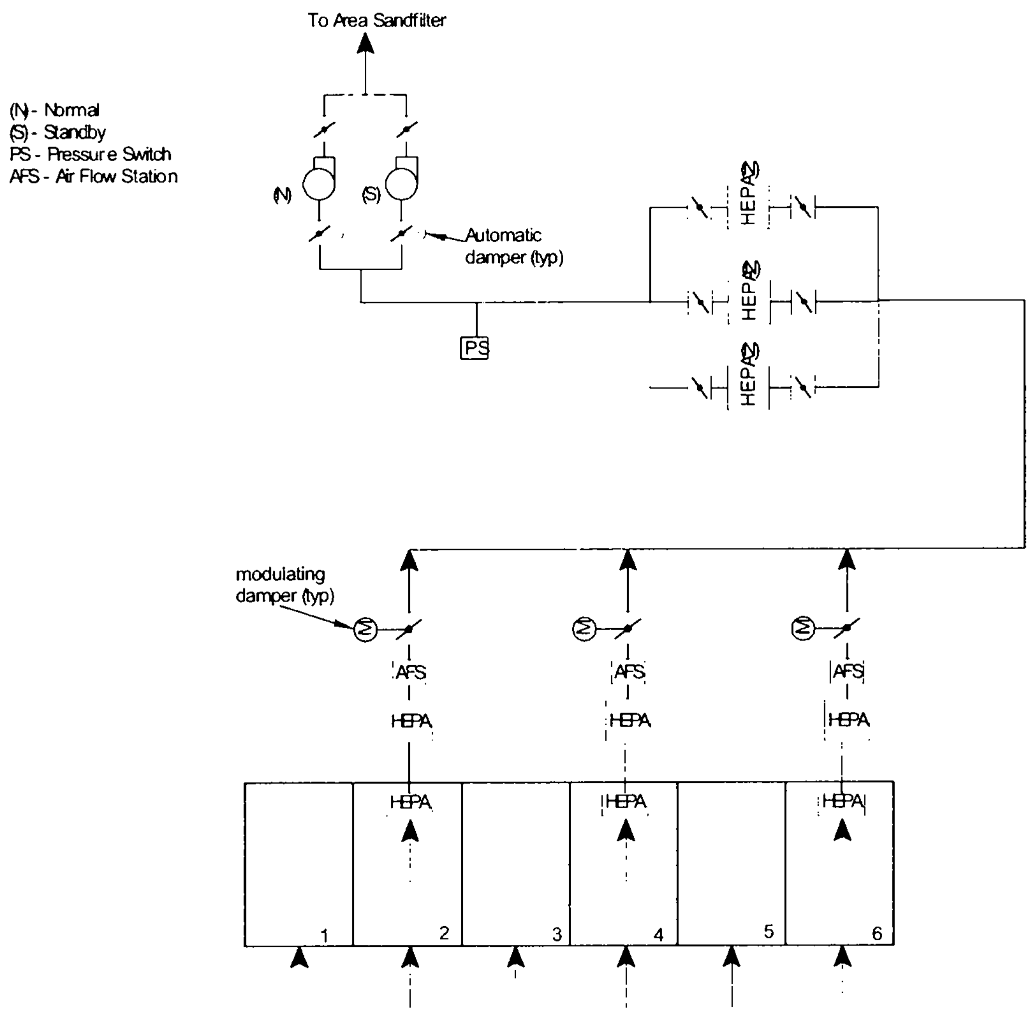
Attachment 1 - Figure H

C Section OGE System - Basic Configuration



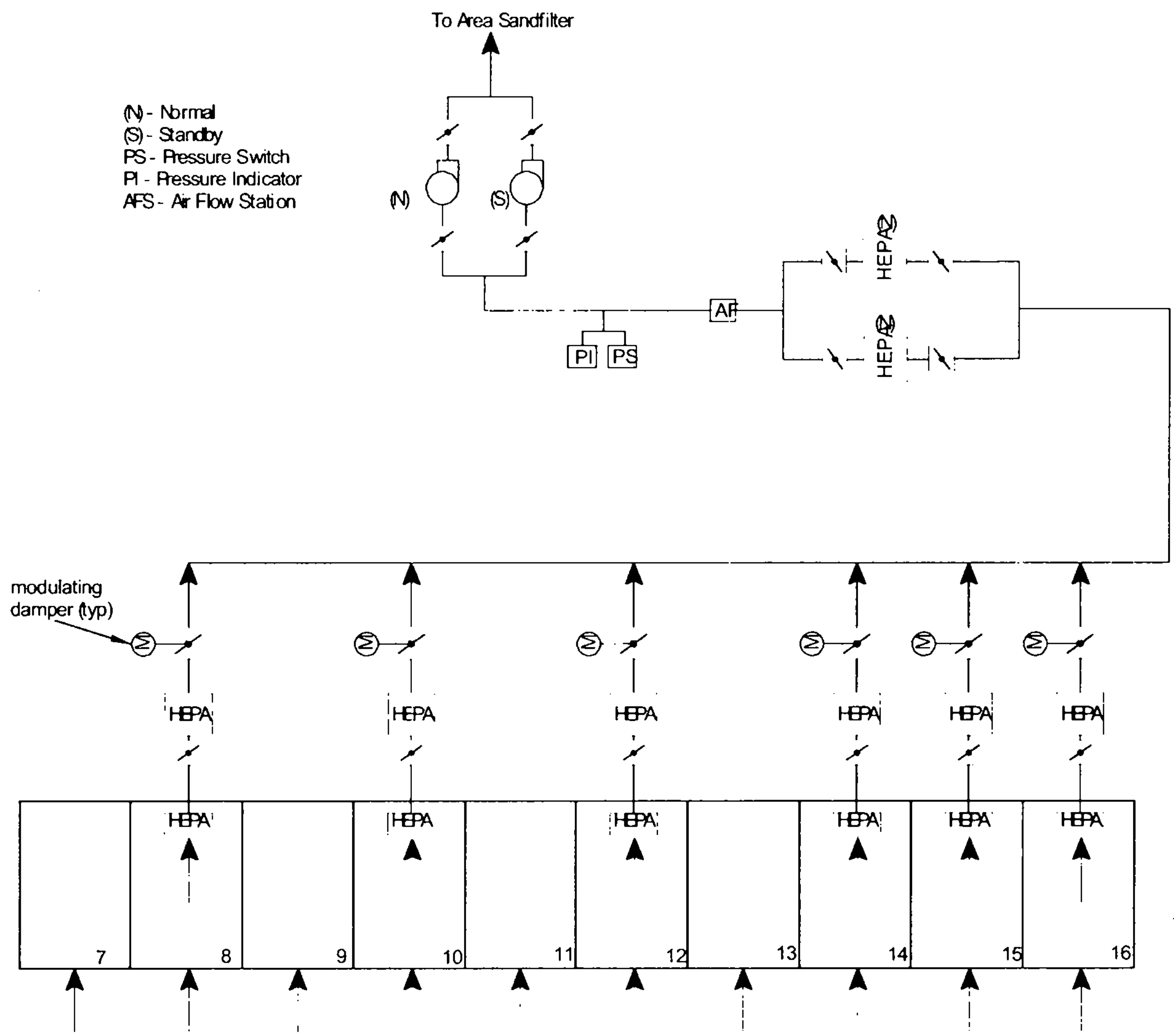
Attachment 1 - Figure I

Building 773-A – Section E Ventilation Single Line



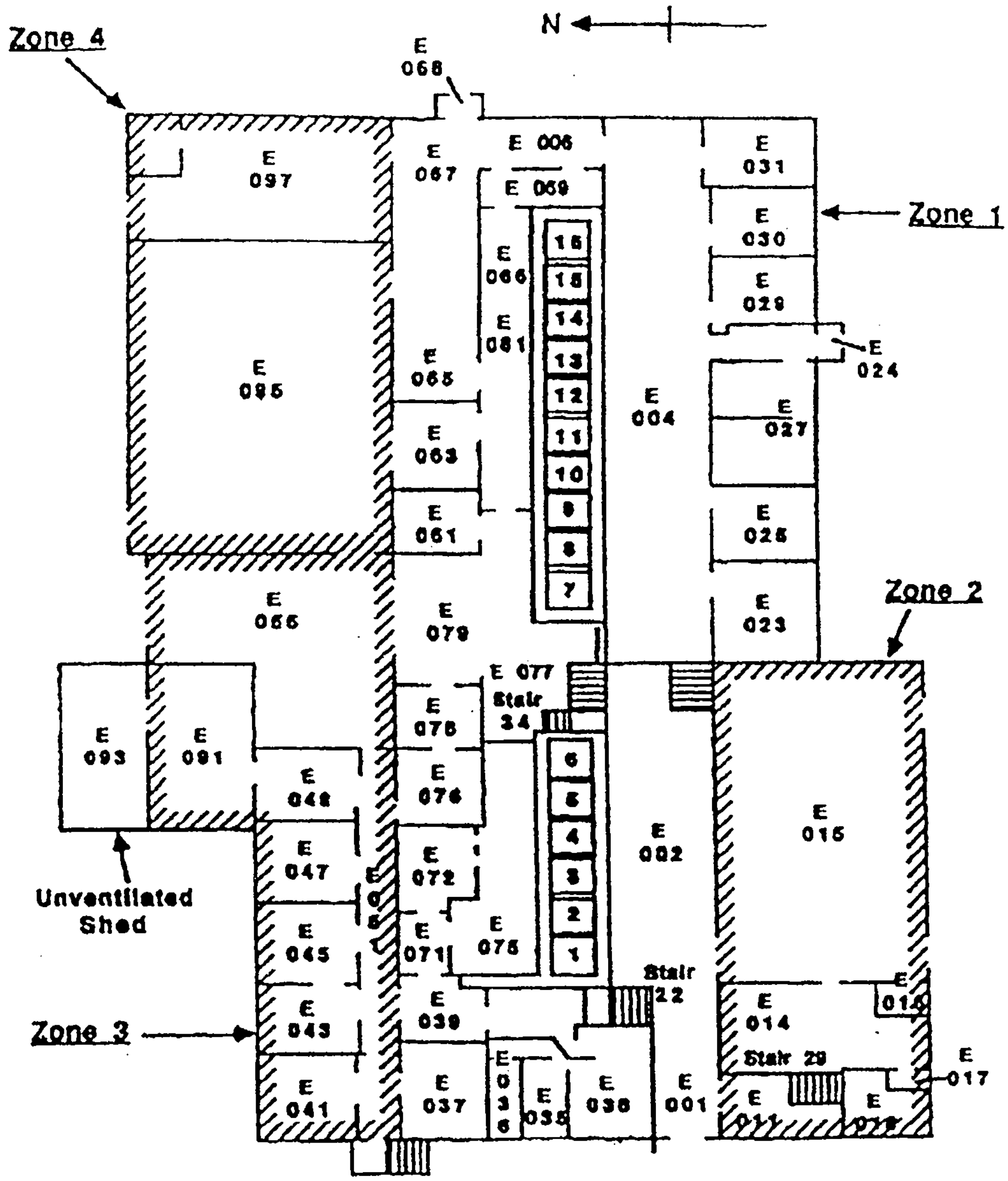
Attachment 1 - Figure J

Section E A Cell Block Exhaust Diagram



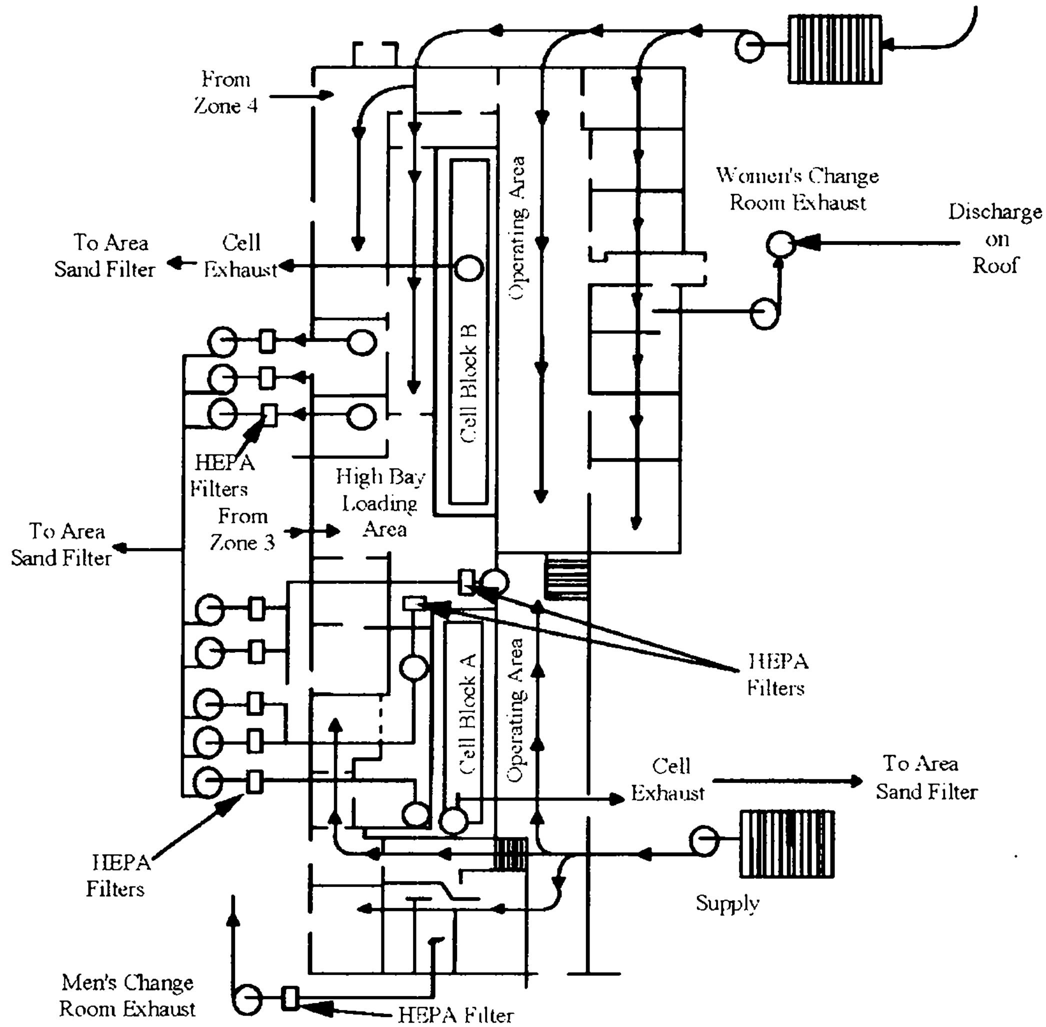
Attachment 1 - Figure K

Section E B Cell Block Exhaust Diagram



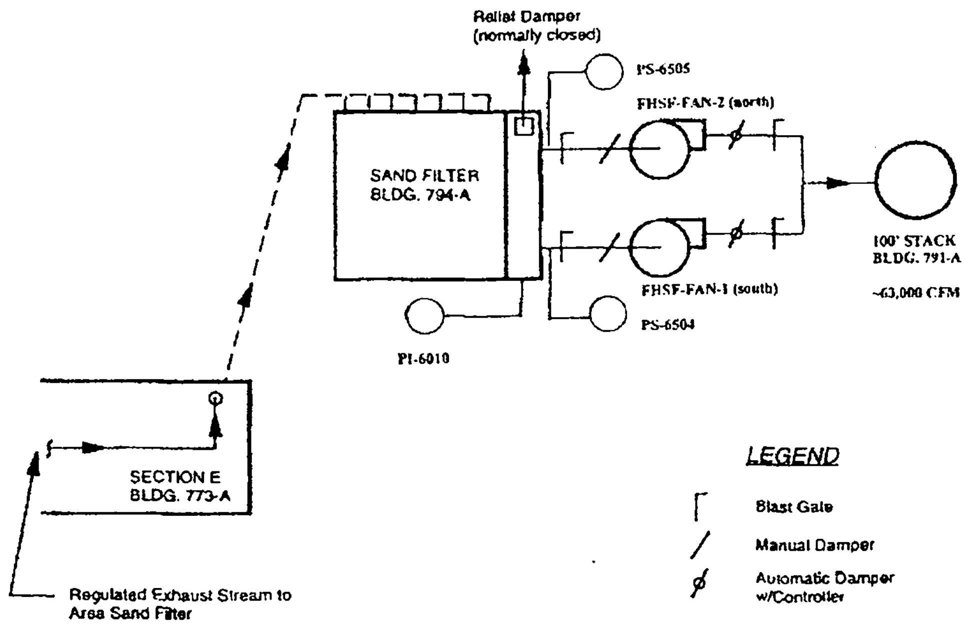
Attachment 1 – Figure L

Building 773-A Ventilation Zones – Section E



Attachment 1 - Figure M

Building 773-A Zone 1 Service Floor Ventilation - Section E



SAND FILTER EXHAUST STREAM

NORMAL OPERATION

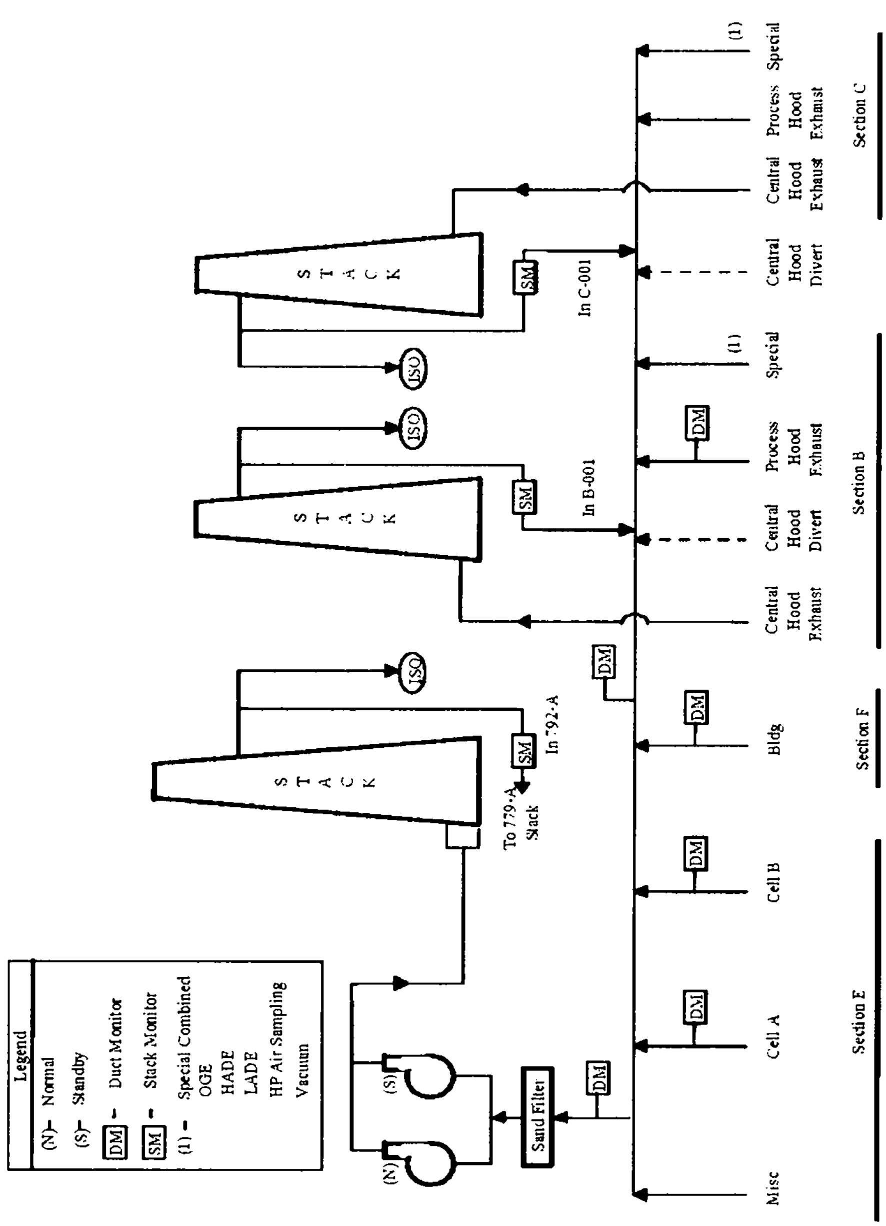
Sections B, C & F Process Hood Exhaust
Sections B/F & C Off-Gas Exhaust
Building Vacuum System Exhaust
Section E Cell Exhaust
Section E Regulated Room Exhaust
Section E Local Hood Exhaust
Sections B & C Low Activity Drain Exhaust
Sections B & C High Activity Drain Exhaust
Air Sampling Exhaust

ABNORMAL OPERATION

Sections B & C Process Hood Exhaust
Section F (reduced) Process Hood Exhaust
Sections B & C Off-Gas Exhaust
Building Vacuum System Exhaust
Section E Cell Exhaust
Section E Regulated Room Exhaust
Section E Local Hood Exhaust
Sections B & C Low Activity Drain Exhaust
Sections B & C High Activity Drain Exhaust
Air Sampling Exhaust
Diverted Section B or C Central Hood
Exhaust (reduced flow)

Attachment 1 - Figure N

Sand Filter Flow Diagram



Attachment 1 - Figure O

Schematic Building 773-A Exhausts, Stack Monitor Locations

Attachment 1 – Figure P

Pictorial Representation of Tape-In-Place HEPA Filter Housing

Attachment 2 (Page 1 of 4)

Copy of Table 4-3 Attachment 1 from SRNL-ROE-2007-00063

Table 4-3: Confinement Documented Safety Analysis Information

Facility = SRNL Building 773-A				Hazard Category 2					Performance Expectations		
Bounding Accidents	**Type Confinement**		**Doses**		**Confinement Classification**			**Safety Function**	**Functional Requirements**	**Performance Criteria**	**Compensatory Measures**
	Active	**Passive**	**Unmitigated (Notes 1, 6)**	**Mitigated**	**SC**	**SS**	**DID**				
Fire – Fire starting in Room or Laboratory (does not spread beyond initial lab) HA Event C-400b	Not Credited	Not Credited	MOI – 0.21 rem CW = 1.1 rem	NA	NA	NA	NA	NA	NA	NA	NA
Fire – Full building fire HA Event CH-100	Not Credited	Not Credited	MOI – 0.62 rem CW = 3.2 rem	NA	NA	NA	NA	NA	NA	NA	NA
Explosion - Unstable Lab Chemical Explosion in Section B, C or E Laboratory, Section C Intermediate Level Cell (ILC), or Section E High Level Cell (HLC) (Note 2) HA Event E-401a	Not Credited	HL Cell Exhaust, B&C CHEX, B&C PHEX, B/F and C OGE, and F-PHEX. Confinement includes the boundary of Lab module, glovebox, or cell plus the ductwork from the enclosure through (and including) a testable HEPA filter.	MOI – 0.31 rem CW = 1.5 rem	NA	NA	X	NA	The SS classification is based on a qualitative evaluation of postulated accidents that determined that the confinement function provides protection to the in-facility worker.	Confinement of airborne radionuclides to the Lab module, glovebox, or cell where the explosion occurred plus associated ventilation exhaust system ductwork. (Note 3)	Maintain structural integrity during and after a low-energy explosion. Periodic verification of the system testable HEPA filter efficiency to ensure the integrity of the filter as installed.	NA

Attachment 2 (Page 2 of 4)

Copy of Table 4-3 Attachment 1 from SRNL-ROE-2007-00063

Table 4-3: Confinement Documented Safety Analysis Information

Facility = SRNL Building 773-A					Hazard Category 2				Performance Expectations			
Bounding Accidents	**Type Confinement**		**Doses**		**Confinement Classification**			**Safety Function**	**Functional Requirements**	**Performance Criteria**	**Compensatory Measures**	
	Active	**Passive**	**Unmitigated (Notes 1, 6)**	**Mitigated**	**SC**	**SS**	**DID**					
Explosion – **Glovebox (GB) Overpressurization** (from valve failure) in Non-Section E Room HA Event C-401c	Not Credited	Not Credited	MOI – **1.9 rem** CW – 9.6 rem	NA	NA	NA	NA	NA	NA	NA	NA	
Explosion - **FG Explosion from accumulation of process FG (PFG) or VOCs** generated within a HLC, ILC, or GB **followed by a full building fire**. HA Event E-402	Active exhaust systems sweep out PFG or VOCs generated within respective enclosure to prevent explosion from occurring	HLC, ILC, or GB in conjunction with respective active exhaust system plus ductwork from enclosure through (and including) a testable HEPA filter	MOI – **2.2 rem** CW – 10.5 rem	NA	NA	X	NA	The SS classification is based on a qualitative evaluation of postulated accidents that determined that the active function to sweep out PFG and VOCs and the confinement function provide protection to the in-facility worker.	Ventilation exhaust systems are required to be operable prior to, but not during or after, the explosion event. (Note 4)	HLC Cell Exhaust System flow rate must be ≥specified value in TSR LCO. OGE Exhaust System plenum vacuum must be ≥specified value in TSR LCO. HEPA filter efficiency must be ≥specified value in TSR LCO SR.	NA	

Attachment 2 (Page 3 of 4)

Copy of Table 4-3 Attachment 1 from SRNL-ROE-2007-00063

Table 4-3: Confinement Documented Safety Analysis Information												
Facility = SRNL Building 773-A				**Hazard Category 2**					**Performance Expectations**			
Bounding Accidents	**Type Confinement**		**Doses**		**Confinement Classification**			**Safety Function**	**Functional Requirements**	**Performance Criteria**	**Compensatory Measures**
	Active	**Passive**	**Unmitigated (Notes 1, 6)**	**Mitigated**	**SC**	**SS**	**DID**				
Explosion – **FG Explosion from accumulation of distributed FG** in non-Section E Room, **followed by full building fire**. HA Event C-402	Active CHEX Systems sweep out distributed FG leaking into FG labs to prevent FG explosion from occurring	Not Credited	MOI = **2.2 rem** CW = 10.8 rem	NA	NA	X	NA	The SS classification is based on a qualitative evaluation of postulated accidents that determined that the active function to sweep out distributed FG provides protection to the in-facility worker.	CHEX Systems are required to be operable prior to, but not during or after, the explosion event. (Notes 4 and 5)	CHEX System plenum vacuum must be ≥specified value in TSR LCO.	NA
Spill – Spill inside Section E shielded cell HA Event E-407	Not Credited	Not Credited	MOI = 0.31 rem CW – 1.5 rem	NA	NA	NA	NA	NA	NA	NA	NA
NPH Event – Earthquake (no consequential fire) HA Event CH-109	Not Credited	Not Credited	MOI = 0.64 rem CW = 3.2 rem	NA	NA	NA	NA	NA	NA	NA	NA

Attachment 2 (Page 4 of 4)

Copy of Table 4-3 Attachment 1 from SRNL-ROE-2007-00063

Table 4-3: Confinement Documented Safety Analysis Information												
Facility = SRNL Building 773-A					Hazard Category 2				Performance Expectations			
Bounding Accidents	Type Confinement		Doses		Confinement Classification			Safety Function	Functional Requirements	Performance Criteria	Compensatory Measures
	Active	Passive	Unmitigated (Notes 1, 6)	Mitigated	SC	SS	DID				
NPH Event – **Earthquake + Consequential Fire + Explosion** HA Event CH-110	Not Credited	Not Credited	MOI – **1.6 rem** CW – 8.1 rem	NA	NA	NA	NA	NA	NA	NA	NA
NPH Event – **Tornado / High Winds** (no consequential fire) HA Event CH-112	Not Credited	Not Credited	MOI – **1.1 rem** CW – 2.7 rem	NA	NA	NA	NA	NA	NA	NA	NA
NPH Event – **Tornado / High Winds + Consequential Fire** HA Event CH-113	Not Credited	Not Credited	MOI – **1.9 rem** CW – 6.6 rem	NA	NA	NA	NA	NA	NA	NA	NA

Notes

1. The accident analysis dose consequences (S-CLC-A-00130, Rev. 0) used 'falling object' ARF*RF values based upon the assumption that the basic concrete structures of Sections B and C of Building 773-A and the Section E Shielded Cells will not collapse during a fire, explosion, or earthquake event. This limits the kinetic energy of falling objects that strike radioactive materials during these events. However, these structures are not credited with any dose reduction function, i.e., LPF = 1.0 in all events.
2. The Unstable Lab Chemical Explosion is a "low-energy" explosion that does not challenge the integrity of the Lab Module or ventilation exhaust system.
3. The HEPA filter forms part of the passive confinement boundary, but is not credited with a dose reduction function. Operation of the exhaust fans is not needed to support this function.
4. The normal status of the exhaust system is that it is operating (i.e., not in standby). The monitoring system must provide an indication of the exhaust flow. If the system becomes inoperative, all operations in the affected enclosures are stopped and hazardous materials and energy sources are put in a stable condition.
5. The CHEX system also has an alarm on degradation / loss of CHEX flow. If the system becomes inoperative, all operations in the affected FG labs are stopped and the distributed FG supply shut off.

MOI – Maximally Exposed Offsite Individual (public) CW – Co-located worker (at 100m)

Attachment 3

Radiological Dose Criteria from Consolidated Hazards Analysis Manual (Reference A)

Consequence Level	Offsite Receptor Consequences (MOI)	Onsite Worker #1 Consequences (Inside the facility)	Onsite Worker #2 Consequences (Outside the facility/CW)
High	Consequences greater than or equal to 25 rem	Consequences greater than or equal to 100 rem	Consequences greater than or equal to 100 rem
Moderate	Consequence greater than or equal to 5 rem and less than 25 rem	Consequences greater than or equal to 25 rem and less than 100 rem	Consequences greater than or equal to 25 rem and less than 100 rem
Low	Consequence greater than or equal to 0.5 rem and less than 5 rem	Consequences greater than or equal to 5 rem and less than 25 rem	Consequences greater than or equal to 5 rem and less than 25 rem
Negligible	Consequences less than Low level	Consequences less than Low level	Consequences less than Low level

Attachment 4

Table 1 - Events Excluded from Evaluation as Part of Table 5-1

Event Category	Basis
Fire - Room or Laboratory only	Per Reference B Page 21 and 22 Discussion, the evaluation of internal fire events for an existing facility is only required if the accident analysis takes credit for the active confinement ventilation system.
Fire - Full Facility	Per Reference B Page 21 and 22 Discussion, the evaluation of internal fire events for an existing facility is only required if the accident analysis takes credit for the active confinement ventilation system.
Explosion - Accumulation of Process Flammable Gas or VOCs followed by a full building fire	Per Reference B Page 21 and 22 Discussion, the evaluation of internal fire events for an existing facility is only required if the accident analysis takes credit for the active confinement ventilation system.
Explosion - Accumulation of Distributed Flammable Gas followed by full building fire	Per Reference B Page 21 and 22 Discussion, the evaluation of internal fire events for an existing facility is only required if the accident analysis takes credit for the active confinement ventilation system.
NPH Event - Earthquake with no consequential fire	Per Reference C Caution 4 and Reference B Page 22 Discussion, the evaluation of seismic events is only required if the accident analysis takes credit for the active confinement ventilation system during or after the NPH event.
NPH Event - Earthquake with consequential fire and explosion	Per Reference C Caution 4 and Reference B Page 22 Discussion, the evaluation of seismic events is only required if the accident analysis takes credit for the active confinement ventilation system during or after the NPH event.
NPH Event - Tornado/High Winds with no consequential fire	Per Reference C Caution 4 and Reference B Pages 22 and 23 Discussion, the evaluation of tornado and wind events is only required if the accident analysis takes credit for the active confinement ventilation system during or after the NPH event.
NPH Event - Tornado/High Winds with consequential fire	Per Reference C Caution 4 and Reference B Pages 22 and 23 Discussion, the evaluation of tornado and wind events is only required if the accident analysis takes credit for the active confinement ventilation system during or after the NPH event.
NPH Event - Flooding and Precipitation	Per Reference C Caution 4 and Reference B Page 23 Discussion, the evaluation of other NPH events is only required if the accident analysis takes credit for the active confinement ventilation system during or after the NPH event.
NPH Event - Lightning with no Fire	Per Reference C Caution 4 and Reference B Page 23 Discussion, the evaluation of other NPH events is only required if the accident analysis takes credit for the active confinement ventilation system during or after the NPH event.
External Events with no Fire	Reference G Tables 3.4-2 and 3.4-4 indicates no release without a consequential fire.

Credible events from the DSA Tables 3.4-2 and 3.4-4 (Reference G) are listed in Attachment 2. The events have been evaluated against the guidance provided in References B and C. Table 1 provides a list of events, and associated basis, that do not need to be evaluated during Table 5-1 Report development.

Attachment 5 (Page 1 of 2)

Justification for Sections and Systems Excluded by 4-3 Report

The evaluation will exclude the following Sections of 773-A. They are:

- Section A (or A Wing) of the building does not have a radioactive material inventory (other than sealed sources), and does not provide a confinement function. The section is segregated from the balance of 773-A with a non-DSA credited 2-hr fire barrier. Therefore, if segmented from the balance of 773-A this section would be considered an Other Industrial Facility.
- Section D (or D Wing) where the inventory (DSA Table 3.4.1-1) is less than Hazard Category 3 limit. The inventory contributes less than 1 mrem to the MOI or co-located worker for the full facility NPH events analyzed in the DSA. The section is segregated from the balance of 773-A with a non-DSA credited 2-hr fire barrier. Therefore, if segmented from the balance of 773-A this section would be considered a Radiological Facility.

The evaluation will exclude the following Systems in 773-A. They are:

- Building Central Vacuum System (VAC) – This system exhausts from 0 to 50 cfm as needed from vacuum ports in lab modules located in 773-A Sections B, C, D and F. The air passes through a HEPA filter before reaching the vacuum pump and is then discharged to the SRNL Sand Filter.
- Low Activity Drain Exhaust (LAD) – Identical systems in Sections B and C provide a forced air sweep through the gravity drain system for low specific activity liquid waste from the lab bench sink and/or floor drain in laboratory modules. 150 cfm is exhausted from each piping system, passes through a HEPA filter before reaching the fan and is then discharged to the SRNL Sand Filter.
- High Activity Drain Exhaust (HAD) – Identical systems in Sections B and C provide a forced air sweep through the gravity drain system for high specific activity liquid waste (lab sample disposal) from laboratory module radiohoods and gloveboxes. The system prevents residual dried contamination in the piping from migrating back into the hoods or gloveboxes. 75 cfm is exhausted from each piping system, passes through a HEPA filter before reaching the fan and is then discharged to the SRNL Sand Filter.

Attachment 5 (Page 2 of 2)

Justification for Sections and Systems Excluded by 4-3 Report

- Air Monitoring/Stack Air Activity Monitoring (AM/SAAM) – Similar systems in Sections B and C provides the motive force for the Retrospective Air Samplers, Duct Monitors, Continuous Air Monitors, Stack Samples and Stack Monitors. Each individual sample flow varies from 1 to 3 cfm with between 300 and 400 sample locations operational at any one time in Sections B, C, D, E and F. The 500 to 1000 cfm is pulled through the filter paper at the various sample points before entering the fans and is then discharged to the SRNL Sand Filter.

The preceding four systems exhaust a maximum of 1500 cfm (SAAM/Air Monitoring – 1000 cfm, Low Activity Drain Exhaust – 300 cfm, High Activity Drain Exhaust – 150 cfm and Vacuum 50 cfm) of the nominal 210,000 cfm exhausted from 773-A Sections B, C, E and F. This exhaust airflow contributes less than 1% of the total exhaust airflow. Failure of any or all of these systems will not adversely impact the facility confinement function due to the small percentage of total facility airflow and the filtration function of the Sand Filter.

Attachment 6 (Page 1 of 3)

Description of Discretionary Gaps Identified in Table 5-1 Evaluation

Gap Number	Eval. Crit. Number	System Name	Description of Discretionary Gap
1	1.3	B/C-CHEX	Ductwork blanks are not provided between all adjacent filter banks.
2	1.3/2.5	B/C-HVAC	Isolation dampers are not provided to isolate individual portions of the supply system.
3	2.2	B/C-CHEX B/C-PHEX B/C-HVAC	Interlocks are not provided between the supply and exhaust systems.
4	8.1	B/C-CHEX B/C-PHEX	Tape-in-place HEPA filters do not meet the filter housing pressure boundary integrity testing requirements in N510. See Attachment 1 Figure P.
5	8.1	B/C-CHEX	Ductwork blanks are not provided between all adjacent filter banks.
6	10.1	B/C-CHEX	Fan Motor Control Centers (MCCs) are fed by the same diesel generator (D/G).
7	10.1	B/C-CHEX	Performance of two of the four Diversion fans is limited by poor fan inlet conditions (system effect).
8	1.4	B/C-HV	The two B/C-HV sub-systems do not have HEPA filtration.
9	2.1/2.4	B/C-HV	The two B/C-HV sub-systems do not have any local or remote system status instrumentation or alarms.
10	2.3	B/C-HV	Emission points from tertiary confinement zone do not have post accident indication of filter break through.
11	10.1	B/C-HV	Two exhaust sub-systems are not provided with redundant fans.
12	10.2	B/C-HV	The two B/C-HV sub-systems fans do not have automatic back-up power.
13	2.1/2.4	B/C-HVAC	The B/C-HVAC systems do not have any remote system status instrumentation, control or alarms.
14	2.1	B/C-HVAC	There is no ΔP measurement between the atmosphere and the tertiary confinement zones.
15	10.1	B/C-PHEX	Fan MCCs are fed by the same D/G.
16	2.2	B/C-RREX	Interlocks are not provided between supply and exhaust systems.
17	10.1	B/C-RREX	Four exhaust sub-systems are not provided with a standby fan.
18	10.2	B/C-RREX	Fans not provided with automatic backup electrical power.
19	2.1	B/C/F-OGE	Not all gloveboxes are provided with outlet HEPA filter ΔP instrumentation.

Attachment 6 (Page 2 of 3)

Description of Discretionary Gaps Identified in Table 5-1 Evaluation

Gap Number	Eval. Crit. Number	System Name	Description of Discretionary Gap
20	2.1	B/C/F-OGE	Not all gloveboxes are provided with exhaust flow rate instrumentation.
21	2.5/10.1	B/C/F-OGE	Failure of online fan does not automatically start the standby fan.
22	10.1	B/C/F-OGE	Fan MCCs are fed by the same D/G.
23	1.4	E-CE	Cell Block B 3rd stage HEPA filter airflow is greater than the filter rating during individual HEPA filter isolation.
24	1.4	E-CE	Cell Block A 2nd stage HEPA filters and Cell Block A 3rd stage HEPA filter airflow is greater than the filter rating during individual HEPA filter isolation.
25	2.1	E-CE	Cell Block A 2nd Stage HEPA Filters, Cell Block A 3rd stage HEPA filters and Cell Block B 3rd Stage HEPA filters are not provided with differential pressure indicators.
26	2.2	E-CE E-HVAC E-RREX E-LHEX	Interlocks are not provided between the supply and exhaust systems.
27	10.1	E-CE	The two sub-systems are powered from the same MCC, fed by the same D/G.
28	1.4	E-HV	The Women's Change Room Exhaust sub-system exhaust does not have HEPA filtration before being released to the environment.
29	2.1	E-HV	The two sub-systems do not have any local or remote system status instrumentation or alarms.
30	2.3	E-HV	Emission points from tertiary confinement zone do not have post accident indication of filter break through.
31	10.1	E-HV	The two sub-systems do not have redundant fans.
32	10.2	E-HV	The two sub-systems fans do not have automatic back-up power.
33	1.4	E-HVAC	The manipulator shop, a secondary zone, uses re-circulated air without HEPA filtration.
34	2.1	E-HVAC	The systems do not have any remote system status instrumentation, control or alarms.
35	1.4	E-LHEX	High Bay Exhaust sub-system airflow exceeds HEPA filter rated capacity.
36	8.1	E-LHEX	Tape-in-place HEPA filters do not meet the filter housing pressure boundary integrity testing requirements in N510. See Attachment 1 Figure P.
37	10.1	E-LHEX	The Hood Exhaust sub-system does not have redundant fans.

Attachment 6 (Page 3 of 3)

Description of Discretionary Gaps Identified in Table 5-1 Evaluation

Gap Number	Eval. Crit. Number	System Name	Description of Discretionary Gap
38	10.2	E-LHEX	Automatic backup electrical power is not provided for the following E-LHEX sub-systems: High Bay Exhaust and Hood Exhaust.
39	1.4	E-RREX	Two locations have airflow greater than the rated capacity of the HEPA filter.
40	2.1	E-RREX	HEPA filters are not provided with ΔP instrumentation for the Lab and Storage Exhaust sub-system.
41	2.1	E-RREX	The Fan Room Exhaust sub-system does not have any status instrumentation or alarms.
42	8.1	E-RREX	Tape-in-place HEPA filters do not meet the filter housing pressure boundary integrity testing requirements in N510. See Attachment 1 Figure P.
43	10.1	E-RREX	The Fan Room Exhaust sub-system does not have redundant fans.
44	10.2	E-RREX	Automatic backup electrical power is not provided for the following sub-systems: High Bay Exhaust, Lab & Storage Exhaust and Fan Room Exhaust.
45	2.1	F-LHEX	HEPA filters are not provided with ΔP instrumentation.
46	2.1	F-LHEX	The system does not have any status instrumentation or alarms.
47	2.3	F-LHEX	Emission point from tertiary confinement zone does not have post accident indication of filter break through.
48	10.1	F-LHEX	Failure of online fan does not automatically start the standby fan.
49	10.1	F-LHEX	Fans are provided standby power from the same Motor Control Center.
50	2.1	F-PHEX	For CPF and MSF, Cell ΔP is not monitored.
51	2.1	F-PHEX	For four gloveboxes, outlet HEPA filters are not provided with ΔP instrumentation.
52	2.1	F-PHEX	For CPF and MSF, the outlet HEPA filters are not provided with ΔP instrumentation.
53	2.5	F-PHEX	The exhaust fan inlet dampers do not fail safe.
54	8.1	F-PHEX	The MSF tape-in-place HEPA filters do not meet the filter housing pressure boundary integrity testing requirements in N510. See Attachment 1 Figure P.
55	10.1	F-PHEX	Fan MCCs are not distributed across different D/Gs.
56	10.1	FHSF	Fan MCCs are not distributed across different D/Gs.
57	10.2	FHSF	Standby power is not provided for the stack air activity monitoring (SAAM) fans.
58	10.1	CE	Controls for each sub-system redundant fans are powered by a single control transformer.

Attachment 7

2004-2 Table 5-1 Ventilation System Performance Evaluation
SRNL, Building 773-A

Evaluation Criteria	Discussion	Reference
0 - Ventilation System Description & References		
0.1 System Description	N/A	N/A
	System Description The Central Hood Exhaust (CHEX) systems are two independent systems serving Sections B&C with about 30 lab modules in each section. Separate single stage HEPA filter banks serve individual or groups of lab modules. Three of four exhaust fans on-line is the normal operating configuration (Figure A). Air is discharged to a 75 ft stack for each section of the building. In the event of a loss of power, the system reduces to one exhaust fan provided with standby power. In the event of a significant stack release, the normal exhaust fans can be shutdown and a booster fan (with standby) can be started to "divert" reduced airflow to the SRNL Sand Filter. The booster "diversion" fans are provided with standby power. The stack, building framing, roof slabs and floor slabs have been qualified to PC-3. The building shell walls (windows and transite panels) have been qualified to PC-1. Interior partitions, systems and components are qualified to a mixture of PC-1 and PC-2.	

Evaluation Criteria	Discussion	Reference
0.2 System References	N/A <u>Standards</u> o DuPont Specifications 3027, 3017, 8728. o DuPont standard H16J, Flexible connections o M-SPP-G-00243, HEPA Filter Specification o SRS Engineering Standard 15888, HEPA Filter Requirements o ANSI/ASME NQA-1, Quality Assurance Program Requirements for Nuclear Facilities, 1997 o DOE-STD-3020-2005, DOE Technical Standard - Specification for HEPA Filters Used by DOE Contractors o DOE-STD-3025-2007, DOE Technical Standard - Quality Assurance Inspection and Testing of HEPA Filters o UL 586, UL Standard for Safety, High Efficiency, Particulate, Air Filter Units, 1996. <u>References</u> System Design Descriptions (SDDs): o M-SYD-A-00001, CHEX System Design Description o M-SYD-A-00016, CHEX Diversion System Design Description o M-SYD-A-00024, IA, PLTA & Compressor Alternate CW Air Balance Test Procedures (TPs): o TP-02-773A-BWING-01, Sec B Air Balance Test Procedure o TP-03-773A-CWING-01, Sec C Air Balance Test Procedure o 5Q1.2 Procedure 484, Building Air Survey Operator Round Sheets: o ROD-OPS-2002-002 - Control Area Operator (CAO) Round Sheets o ROD-OPS-2002-003 - Facility Operator (FO) Round Sheets Miscellaneous o SRNL-ESD-2007-00017, Structural Integrity Program Scope, Resources & Estimate, 02/07/07 o SRNL-ROE-2007-00063, Table 4.3 submittal o WSRC-SA-2, Revision 3, February 2007, SRNL Technical Area Documented Safety Analysis (DSA) o WSRC-TS-97-00014, SRNL Technical Area (TA) Technical Safety Requirements (TSRs) Drawings o M-M6-A-0183, CHEX Normal Exhaust Fan P&ID - Section B o M-M6-A-0170, CHEX Normal Exhaust Fan P&ID - Section C o M-M6-A-0191, CHEX Diversion Exhaust Fan P&ID - Section B o M-M6-A-0192, CHEX Diversion Exhaust Fan P&ID - Section C	N/A

Evaluation Criteria	Discussion	Reference
1 - Ventilation System – General Criteria		
1.1 Pressure differential should be maintained between zones and atmosphere.	Number of zones as credited by accident analysis to control hazardous material release; demonstrate by use considering potential in-leakage. The Sections B&C zone flows and ventilation system interactions are described in the specific SDD documents (see references in Section 0.2). Differential pressures (DPs) are not measured directly, but are maintained between zones by monitoring and balancing air flows. Periodic monitoring is conducted, including hood face velocities (Procedure 4Q/401) and air flow directions (Procedure 5Q1.2/484). Air balances are regularly conducted on all ventilation systems within a building section to verify facility design basis flows, as documented by the Sections B&C Air Balance test procedures (see references in Section 0.2). Key system parameters are recorded on a daily and weekly basis (operator rounds in Section 0.2) which allows monitoring of ventilation system function and performance. The CHEX/Diversion Systems are designed to maintain the primary containment zones at a negative pressure with respect to surrounding areas such that a positive airflow is maintained into the primary confinement zones from the secondary confinement zones. Confinement Zones o Primary Confinement — Lab Hoods / Gloveboxes / Ducting through 1st testable HEPA filter stage o Secondary Confinement — Labs / Filter Rooms / Equipment Rooms / Service Corridor o Tertiary Confinement — Personnel Corridors / Offices / General Service Floor Area o Administrative Area — Sections A&D / Offices Gap Analysis No Gaps - Pressure differentials are not measured directly, but are maintained between zones by monitoring and balancing air flows.	DOE-HDBK-1169 (2.2.9) ASHRAE Design Guide

Evaluation Criteria	Discussion	Reference
1.2 Materials of construction should be appropriate for normal, abnormal and accident conditions.	[DOE Guidance Document does not provide any specific evaluation guidance discussion for this criteria] CHEX (Normal Exhaust) Systems Sections B&C CHEX systems transport noxious fumes, as well as radioactive contamination from laboratories to the shielded area (filter room). Ducting is Level 4, class II. Ducting is welded from 16 gauge 304 stainless steel with bolted, flanged joints Joints are connected with 1/8" thick full face neoprene gaskets. Ducting from lab modules connects to the primary filter ("dirty") plenum which supplies parallel HEPA filter assemblies. Filter assembly housings and framework are fabricated from stainless steel and discharge to a secondary filter ("clean") plenum. The secondary filter plenum discharges to an underground plenum constructed of reinforced concrete and lined with Amercoat panels. The underground plenum extends from the filter room to the equipment room where the CHEX fans connect to it and then discharge to the building stack. The stack is concrete with a chemical resistant coating. CHEX fans are epoxy coated steel. Flexible connections are neoprene fabric collars over stainless steel spool pieces. CHEX (Diversion Exhaust) Systems Sections B&C CHEX Diversion systems reroute exhaust air from the CHEX systems to the Fan Housing Sand Filter (FHSF) supply duct when B or C stack monitoring systems detect radioactivity above predetermined levels. The CHEX Diversion system ducting is stainless steel. CHEX Diversion system fans are fabricated from carbon steel. Gap Analysis No Gaps - All materials of construction are appropriate for normal, abnormal and accident conditions. Inspections conducted as part of the Structural Integrity Program on the inside of the Sections B&C HEPA ductwork to date have shown no reasons why the ventilation system cannot perform it's intended function during all conditions.	DOE-HDBK-1169 (2.2.5) ASME AG-1

Evaluation Criteria	Discussion	Reference
1.3 Exhaust system should withstand anticipated normal, abnormal and accident system conditions and maintain confinement integrity.	As required by accident analysis to prevent accident release.	DOE-HDBK-1169 (2.4) ASHRAE Design Guide
	The 773-A Building ventilation system consists of intake and exhaust ducting, dampers, fans, filters banks, associated controls and instrumentation. The 773-A Building ventilation system minimizes the potential release of radioactive contamination in the event of a process leak. The ventilation system is designed to maintain the building at a slight negative pressure with respect to its surrounding. The CHEX systems, along with OGE and PHEX, are designed to maintain the primary containment zones at a negative pressure with respect to surrounding areas such that a positive airflow is maintained into the primary confinement zones from the secondary confinement zones and into the secondary confinement zones from the tertiary confinement zones. During normal operation these multiple systems run continuously within defined performance parameters to maintain the proper containment air flow. All exhaust air flows except HV systems are filtered through HEPA filters. The PHEX, OGE, and CHEX (Diversion Exhaust) systems exhaust to the Sand Filter (FHSF) system. The ventilation system components are adequate for normal and most abnormal operation. Abnormal conditions include power failure, partial shutdown, or activation of the CHEX (Diversion Exhaust) system. In the event of a power failure, conditioned air will be supplied to tertiary confinement zones only. All supply systems receiving outside air have freezestats to automatically shut the fans down to prevent component damage due to freezing temperatures. Office and laboratory supply fans share a common outside inlet and windbox. Supply air (HVAC) fans that supply laboratory spaces have automatic dampers on the fan discharge that close if the fan is de-energized to prevent the possibility of the backflow of air from the laboratories to the inlet of the office supply fans. Partial shutdown of ventilation systems is addressed by operating procedures TO-06-011, Reduction/Restoration of C Section CHEX and TO-06-015, Reduction/Restoration of B Section CHEX. Activation of the CHEX Diversion system shuts down approximately 2/3rds of the Sections B&C supply air (HVAC) fans to insure that the facility air balance is maintained. The following accident scenarios are considered. Process Explosion - Unstable Lab Chemical or Accumulation of Process Flammable Gas or VOCs with no consequential fire - Ventilation systems would operate normally to maintain a positive pressure differential into the effected lab. Exhaust flows through HEPA filtration are believed adequate to contain mobilized contaminants. If the HEPA plugs, the contaminants would be contained within the lab and ductwork. If the HEPA is compromised and contamination is detected in the B or C stack, the CHEX Diversion system would be placed in service to direct exhaust air to the Sand Filter. If a filter housing or ducting is compromised, the RREX (Exhaust) systems would contain the contamination. Fire detection systems would alert Control Room Operators who would shut down ventilation systems according to procedures. Lab/Cell walls, Gloveboxes, and ductwork would passively contain contaminants. Explosion - Glovebox Overpressurization - same as above. Explosion - Accumulation of Distributed Flammable Gas with no consequential fire - same as above. Drop / Spill - Ventilation systems would operate normally to draw lab/cell air towards hoods. Normal room infiltration would contain the spill to the effected lab/cell. Exhaust flows through HEPA filtration are believed adequate to contain mobilized contaminants. If the HEPA plugs, the contaminants would be contained within the lab and ductwork. If the HEPA is	

Evaluation Criteria	Discussion	Reference
	compromised and contamination is detected in the B or C stack, the Diversion system would be placed in service to direct exhaust air to the Sand Filter. If filter housings or ducting are compromised, the RREX systems would contain the contamination. <u>Gap Analysis</u> Gap Number 1: Discretionary Gap - Ductwork blanks are not provided between all adjacent filter banks.	

Evaluation Criteria	Discussion	Reference
1.4 Confinement ventilation systems shall have appropriate filtration to minimize release.	Address: 1) Type of filter (e.g., HEPA, sand, sintered metal); 2) Filter sizing (flow capacity and pressure drop); 3) Decontamination Factor vs. accident analysis assumptions.	ASME AG-1 DOE-HDBK-1169 (2.2.1)
	CHEX (Normal Exhaust) Systems Separate Sections B&C CHEX systems utilize parallel banks of one pre-filter and either one or two HEPA filters in series. Both "slide in/tape in place" and "bag-in/bag-out" configurations are used. Section B also has two nonstandard cabinet housings. Filters used are listed below. A review of air balance data indicates that all HEPA filters are properly sized. Prior to receipt the filters are tested at the Independent Filter Testing Facility (FTF) to confirm an efficiency of at least 99.97% for a decontamination factor DF = 3333. Decontamination factor has not been considered in the facility DSA. The filters are credited with confinement function only, not dose reduction. HEPA Filters "slide in/tape in place" - 24x30x11-1/2, 1250 cfm @ 1.0 in wc, plywood frame, back neoprene gasket , Stores code 32.1850.04, Flanders Filters Drawing Z95295, Rev. B "bag-in/bag-out" - 24x24x11-1/2, 1500 cfm @ 1.3 in wc, plywood frame, upstream fluid seal, stores code 32.1729.03 or 32.5763.01, Flanders Filters Drawing F0202587, Rev. B nonstandard - 24x30x11-1/2, 1250 cfm @ 1.0 in wc, plywood frame, upstream neoprene gasket, special Flanders Filter, Sec B Prefilters - "bag-in/bag-out" - 24x24x2 (stores code 50.16278), Am Filter 301 or Farr Co 30/30 Class 1 "slide in/tape in place" - 20x25x2 (stores code 50.16130), Am Filter 301 or Farr Co 30/30 Class 1 <u>Gap Analysis</u> No Gaps CHEX (Diversion Exhaust) Systems Separate Sections B&C Diversion Exhaust systems connect to the exhaust plenum after filtration. The additional filtration is provide by the SRNL Sand Filter which is evaluated in a separate report. <u>Gap Analysis</u> No Gaps	

Evaluation Criteria	Discussion	Reference
	2 - Ventilation System – Instrumentation & Control	
2.1 Provide system status instrumentation and/or alarms.	Address key information to ensure system operability (e.g., system delta-P, filter pressure drop).	ASME AG-1 DOE-HDBK-1169 ASHRAE Design Guide (Section 4)
	CHEX (Exhaust) Systems The Sections B&C CHEX systems (four fans per section) are instrumented on the Process Suite Vision (PSV) control system in the C041 CR to show fan status on two separate screens. All of the fan alarms and HEPA filter DP (high and low) indications are routed to the CR. The Section B abnormal DPs are displayed per HEPA bank, while the Section C abnormal DPs are displayed by quadrant (per eight HEPA banks). <u>Gap Analysis</u> No Gaps CHEX (Diversion Exhaust) Systems The Sections B&C CHEX diversion exhaust systems (two fans per section) are instrumented on the PSV control system in the C041 CR to show fan status, as well as on the cabinet status boards (#2 for B, #5 for C). All of the fan alarms associated with diversion are also routed to the CR. <u>Gap Analysis</u> No Gaps	
2.2 Interlock supply and exhaust fans to prevent positive pressure differential.	[DOE Guidance Document does not provide any specific evaluation guidance discussion for this criteria]	DOE-HDBK-1169 ASHRAE Design Guide (Section 4)
	Supply and exhaust fans are not interlocked. CHEX (Normal Exhaust) Systems The Sections B&C CHEX normal exhaust fans (four per section) are not interlocked with their HVAC supply fan counterparts to prevent positive DPs. <u>Gap Analysis</u> Gap Number 3: Discretionary Gap - Interlocks are not provided between the supply and exhaust systems. CHEX (Diversion Exhaust) Systems The Sections B&C CHEX Diversion exhaust fans (two per section) are used during upset conditions, and once activated, selected HVAC supply units in Sections B, C & F are automatically shut down to minimize positive DPs. <u>Gap Analysis</u> No Gaps - CHEX (Diversion Exhaust) interlocks are already provided to prevent positive DPs.	

Evaluation Criteria	Discussion	Reference
2.3 Post accident indication of filter break-through.	Instrumentation supports post accident planning and response; should be considered critical instrumentation for SC. CHEX (Normal Exhaust) Systems Sections B&C CHEX (Normal Exhaust) systems have both low HEPA filter DP indicators, indicating breakthrough, and stack activity monitoring. Separate B&C Stack Monitoring systems are in place to detect radioactivity above preset conditions. <u>Gap Analysis</u> No Gaps CHEX (Diversion Exhaust) Systems The Sections B&C CHEX (Diversion Exhaust) systems do not involve HEPA filters, but are designed for post accident mitigation. The Sand Filter Stack is equipped with an isokinetic sampling system to continuously monitor exhaust air flow and activity. <u>Gap Analysis</u> No Gaps - The Sections B&C CHEX (Diversion Exhaust) systems offer post accident mitigating options should HEPA filter breakthrough and/or high stack activity be determined.	TECH-34

Evaluation Criteria	Discussion	Reference
2.4 Reliability of control system to maintain confinement function under normal, abnormal and accident conditions.	Address, for example, impacts of potential common mode failures from events that would require active confinement function.	DOE-HDBK-1169 (2.4)
	The reliability of the ventilation systems during normal operation is addressed by the TSR, operating procedures, and fail safe design. CHEX (Normal Exhaust) Systems Sections B&C each contain four parallel CHEX fans. Normally three fans are running and one fan is in standby. In the event of a power failure, standby power is supplied to all CHEX fans. One fan in each section will restart automatically and the other fans can be restarted manually. Partial shutdown of ventilation systems is addressed by operating procedures TO-06-011, Reduction/Restoration of C Section CHEX and TO-06-015, Reduction/Restoration of B Section CHEX. The Diversion systems for B and C Sections each include two parallel Diversion fans. One Diversion fan is available and the second fan is in standby. If the Diversion system is activated, the CHEX fans for the affected section are shut down automatically. The Sections B&C CHEX (Normal Exhaust) system fans are continuously monitored by Operations personnel in the Control Room. System is capable of being controlled manually at each fan if necessary. Operation of the systems is controlled by operating procedures. System control is maintained during abnormal and accident conditions by AOPs and EOPs. Gap Analysis No Gaps - PSV control system for the Section B&C CHEX (Normal Exhaust) systems, along with standby and backup power supplies, maintain confinement. CHEX (Diversion Exhaust) Systems If the primary Diversion fan fails the standby fan is automatically energized. Only one Diversion system can operate at a time. The Sections B&C CHEX (Diversion Exhaust) system fans only operate during abnormal and accident conditions. They are controlled manually with standby power backup on the Process Suite Vision (PSV) control system in the C041 CR. Under the four accident scenarios, the CHEX systems would function normally. Gap Analysis No Gaps - The Sections B&C CHEX (Diversion Exhaust) systems are designed for abnormal and accident conditions by operating procedures.	

Evaluation Criteria	Discussion	Reference
2.5 Control components should fail safe.	[DOE Guidance Document does not provide any specific evaluation guidance discussion for this criteria]	DOE-HDBK-1169 (2.4)
	CHEX (Normal Exhaust) Systems The Sections B&C CHEX exhaust system fans have discharge dampers that consistently fail open on loss of instrument air and fail closed on loss of power. CHEX (Diversion Exhaust) Systems The Sections B&C CHEX diversion exhaust system fans have discharge dampers that fail closed on loss of power or instrument air, and diversion dampers that fail closed on loss of power and in last position on loss of instrument air. <u>Gap Analysis</u> No Gaps - CHEX (Normal & Diversion Exhaust) control components are fail-safe.	

Evaluation Criteria	Discussion	Reference
	3 - Resistance to Internal Events – Fire	
3.1 Confinement ventilation systems should withstand credible fire events and be available to operate and maintain confinement.	Required for new facilities; as required by the accident analysis for existing facilities (discretionary). Must address protection of filter media.	DOE-HDBK-1169 (10.1) DOE-STD-1066
	As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Page 21 and 22 Discussion, the evaluation of internal fire events for an existing facility is only required if the accident analysis takes credit for the active confinement ventilation system.	
3.2 Confinement ventilation systems should not propagate spread of fire.	Required for new facilities; as required by the accident analysis for existing facilities (discretionary). Address fire barriers, fire dampers arrangement.	DOE-HDBK-1169 (10.1) DOE-STD-1066
	As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Page 21 and 22 Discussion, the evaluation of internal fire events for an existing facility is only required if the accident analysis takes credit for the active confinement ventilation system.	

Evaluation Criteria	Discussion	Reference
	4 - Resistance to External Events – Natural Phenomena – Seismic	
4.1 Confinement ventilation systems should safely withstand earthquakes.	If the active CVS system is not credited in a seismic accident condition there is no need to evaluate that performance and/or design attribute for the confinement ventilation system (discretionary). Also, any seismic impact on the confinement ventilation system performance will be based on the current functional requirements in the DSA. NOTE: Seismic requirements may apply to Defense-in-Depth items indirectly for the protection of safety SSCs.	ASME AG-1 (AA) DOE O 420.1B DOE-HDBK-1169 (9.2)
	As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per 2004-2 Ventilation System Evaluation Guidance Addendum, March 6, 2007, Caution 4 and Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Page 22 Discussion, the evaluation of seismic events is only required if the accident analysis takes credit for the active confinement ventilation system during or after the NPH event.	

Evaluation Criteria	Discussion	Reference
5 - Resistance to External Events – Natural Phenomena – Tornado/Wind		
5.1 Confinement ventilation systems should safely withstand tornado depressurization.	If the active CVS is not credited in a tornado condition there is no need to evaluate that performance and/or design attribute for the confinement ventilation system (discretionary). Also, any tornado impact on the confinement ventilation system performance will be based on the current functional requirements in the DSA.	DOE O 420.1B DOE-HDBK-1169 (9.2)
	As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per 2004-2 Ventilation System Evaluation Guidance Addendum, March 6, 2007, Caution 4 and Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Pages 22 and 23 Discussion, the evaluation of tornado and wind events is only required if the accident analysis takes credit for the active confinement ventilation system during or after the NPH event.	
5.2 Confinement ventilation systems should withstand design wind effects on system performance.	If the active CVS is not credited in a wind condition there is no need to evaluate that performance and/or design attribute for the confinement ventilation system (discretionary). Also, any wind impact on the confinement ventilation system performance will be based on the current NP analysis in the DSA.	DOE O 420.1B DOE-HDBK-1169 (9.2)
	As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per 2004-2 Ventilation System Evaluation Guidance Addendum, March 6, 2007, Caution 4 and Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Pages 22 and 23 Discussion, the evaluation of tornado and wind events is only required if the accident analysis takes credit for the active confinement ventilation system during or after the NPH event.	

	Evaluation Criteria	Discussion	Reference
		6 - Other NP Events (eg. flooding, precipitation)	
6.1	Confinement ventilation system should withstand other NP events considered credible in the DSA where the confinement ventilation system is credited.	If the active confinement ventilation system is not credited for this event there is no need to evaluate that performance and/or design attribute for the confinement ventilation system (discretionary). Also, any impact on the confinement ventilation system performance will be based on the current NP analysis in the DSA.	DOE O 420.1B DOE-HDBK-1169 (9.2)
		As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per 2004-2 Ventilation System Evaluation Guidance Addendum, March 6, 2007, Caution 4 and Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Page 23 Discussion, the evaluation of other NPH events is only required if the accident analysis takes credit for the active confinement ventilation system during or after the NPH event.	

Evaluation Criteria	Discussion	Reference
	7 - Range Fires / Dust Storms	
7.1 Administrative controls should be established to protect confinement ventilation systems from barrier threatening events.	Ensure appropriately thought out response to external threat is defined (e.g. pre-fire plan).	DOE O 420.1B
	The Savannah River Forestry Department is responsible for fire fighting efforts in regards to wildland fires. They also have a program of controlled burns and mechanical thinning of underbrush to limit or prevent wildland fires from spreading out of control. If the fire encroaches upon SRNL, the Savannah River Site Fire Department will direct extinguishing efforts. Building 773-A has a current Fire Pre Plan and has procedures to reduce confinement ventilation system air flow (originally developed for electrical system maintenance) that will minimize soot loading of the filters in the ventilation systems. Reference: AOP-06-007 <u>Gap Analysis</u> No Gaps - Administrative controls are sufficient to protect the confinement ventilation systems from barrier threatening events.	

Evaluation Criteria	Discussion	Reference
8 - Testability		
8.1 Design supports the periodic inspection and testing of filters and housing, and test and inspections are conducted periodically.	Ability to test for leakage per intent of N510.	DOE-HDBK-1169 (2.3.8) ASME AG-1 ASME N510
	Surveillance Requirements for the CHEX HEPA filters are specified in the SRNL TSR, WSRC-TS-97-00014, CHEX SR 4.2.2.3. All HEPA filter housings have the capability for in-place testing. This in-place test capability was added in the 1960's and testing points meet the intent of N510. The design of the tape-in-place housings discussed under Criteria 1.4 provides unique challenges in testing filter housing pressure boundary integrity. When the filter banks for multiple labs are manifolded together, the configuration does not ensure uniformity of aerosol challenge. Inspection of the housings is part of the Structural Integrity Program. The system is assessed for material buildup following a process event. CHEX (Normal Exhaust) Systems B&C CHEX (Normal Exhaust) HEPA filters are tested annually to verify that they have an efficiency of greater or equal to 99.5%. <u>Gap Analysis</u> Gap Number 4: Discretionary Gap - Tape-in-place HEPA filters do not meet the filter housing pressure boundary integrity testing requirements in N510. Gap Number 5: Discretionary Gap - Ductwork blanks are not provided between all adjacent filter banks. CHEX (Diversion Exhaust) Systems Separate Section B&C CHEX (Diversion Exhaust) have no filtration. <u>Gap Analysis</u> No Gaps	

Evaluation Criteria	Discussion	Reference
8.2 Instrumentation required to support system operability is calibrated.	Credited instrumentation should have specified calibration / surveillance requirements. Non-safety instrumentation should be calibrated as necessary to support system functionality.	DOE-HDBK-1169 (2.3.8)
	Surveillance Requirements for the CHEX systems are specified in the SRNL TA TSRs (WSRC-TS-97-00014) and included in the CHEX system SDD (M-SYD-A-00001) The Sections B&C CHEX (Normal Exhaust) system monitoring and control components, such as gauges, pressure switches and relays, as well as associated instrument loops, are calibrated on a 18 month frequency for the SS TSR components (6524 loop for B, 6525 loop for C) and on a 36 month frequency for the GS non-TSR components. The Sections B&C CHEX (Diversion Exhaust) system instrumentation and interlock components, such as pressure switches and relays, and associated loops, are calibrated on a 18 month frequency. The pneumatic control calibration is performed in accordance with procedure TE-48-039. Other non-safety instrumentation is calibrated on an as-needed basis. <u>Gap Analysis</u> No Gaps	
8.3 Integrated system performance testing is specified and performed.	Required responses assumed in the accident analysis must be periodically confirmed including any time constraints.	DOE-HDBK-1169 (2.3.8)
	Airflow direction is verified at key points within the building during scheduled inspections to verify that the ventilation systems are functioning as intended. Findings are forwarded to the Design Authority Engineer. Functional startup testing is performed on individual ventilation systems after major maintenance events (ex. the replacement of a fan) to insure that interlocks and controls function as designed. Functional testing is required by the TSR of the B&C CHEX (Normal Exhaust) system plenum low pressure alarms every 18 months. A functional test of the B&C CHEX (Diversion Exhaust) system interlocks which interact with the Section F exhaust fans is required every 18 months in accordance with Operation's Best Management Practice Surveillance Evolutions. A functional test of the B&C CHEX (Diversion Exhaust) system overpressure interlocks is required every 18 months in accordance with Electrical & Instrumentation Preventative Maintenance System. A functional test of the simultaneous B&C CHEX (Diversion Exhaust) system actuation interlock is required every 18 months in accordance with Operation's Best Management Practice Surveillance Evolutions. <u>Gap Analysis</u> No Gaps - Integrated CHEX (Normal and Diversion Exhaust) system performance testing is performed as required.	

Evaluation Criteria	Discussion	Reference
	9 - Maintenance	
9.1 Filter service life program should be established.	Filter life (shelf life, service life, total life) expectancy should be determined. Consider: filter environment, maximum delta-P, radiological loading, age, and potential chemical exposure.	DOE-HDBK-1169 (3.1 & App C)
	CHEX (Normal Exhaust) Systems The Sections B&C CHEX HEPA filters are controlled by TO-06-014, Control of TSR HEPA AET and Engineering Standard 15888 (HEPA Filter Requirements) which is the basis of DOE-HDBK-1169 Appendix C. Maximum HEPA shelf life is three (3) years and maximum HEPA total life is ten (10) years. <u>Gap Analysis</u> No Gaps - The Sections B&C CHEX (Normal Exhaust) HEPA filter maximum service life of 10 years has been established and controlled by the SRNL HEPA Filter Database and Computerized Maintenance Management System. Nominal CHEX HEPA filter changeout plans are begun at seven (7) years (Computerized Maintenance Management System) to ensure compliance with the ten (10) year requirement. CHEX (Diversion Exhaust) Systems Sections B&C CHEX (Diversion Exhaust) system has no HEPA filters. <u>Gap Analysis</u> No Gaps	

Evaluation Criteria	Discussion	Reference
	10 - Single Failure	
10.1 Failure of one component (equipment or control) shall not affect continuous operation.	Address potential failures (example failures - fan, backup power supply, switchgear).	DOE O 420.1B (Facility Safety, Chapter I, Sec. 3.b(8))
	Failure of a single fan for the Sections B&C CHEX (Normal Exhaust) system is backed up by a standby fan. Their fan discharge dampers fail open on loss of instrument air and closed on loss of power. All four fans in each section are provided power by the same motor control center which is provided power from the Sand Filter D/G. Gap Analysis Gap Number 6: Discretionary Gap - Fan Motor Control Centers (MCCs) are fed by the same D/G. Failure of a single fan for the Sections B&C CHEX (Diversion Exhaust) system is backed up by a standby fan. However, the start control loop for both B&C CHEX (Diversion Exhaust) fans must be redesigned so that the standby fan does not always come on line during diversion testing. Gap Analysis Gap Number 7: Discretionary Gap - Performance of two of the four Diversion fans is limited by poor fan inlet conditions (system effect).	
10.2 Automatic backup electrical power shall be provided to all critical instruments and equipment required to operate and monitor the confinement ventilation system.	[DOE Guidance Document does not provide any specific evaluation guidance discussion for this criteria]	DOE-HDBK-1169 (2.2.7)
	CHEX (Normal Exhaust) Systems In the event of a power failure, one of the four CHEX fans in each section will start automatically. The remaining three CHEX fans in each section are provided with standby power, but must be started manually from the Control Room or from local hand switches at the fans. Gap Analysis No Gaps - Standby power is available to all critical instruments and equipment. CHEX (Diversion Exhaust) Systems In the event of a power failure, standby power will be provided to all Diversion fans. If the Diversion fan was running, it will restart automatically. The other fan will be available for normal automatic standby service. Gap Analysis No Gaps - Standby power is available to all critical instruments and equipment.	

Evaluation Criteria	Discussion	Reference
10.3 Backup electrical power shall be provided to all critical instruments and equipment required to operate and monitor the confinement ventilation system.	NOTE: Safety Class is addressed through previous line.	DOE-HDBK-1169 (2.2.7)
	This evaluation criteria is NOT APPLICABLE, as it is an SS-only criteria. SRNL confinement ventilation systems are evaluated to SC criteria.	

Evaluation Criteria	Discussion	Reference
11 - Other Credited Functional Requirements		
11.1 Address any specific functional requirements for the confinement ventilation system (beyond the scope of those above) credited in the DSA.	[DOE Guidance Document does not provide any specific evaluation guidance discussion for this criteria] None <u>Gap Analysis</u> No Gaps	10 CFR 830, Subpart B

Evaluation Criteria	Discussion	Reference
0 - Ventilation System Description & References		
0.1 System Description	N/A System Description The Sections B&C Change/Restroom Heating and Ventilating (HV) exhaust systems are two independent low volume systems that exhaust directly to the atmosphere. No standby fans are provided and the fans are not connected to standby power. The building framing, roof slabs and floor slabs have been qualified to PC-3. The building shell walls (windows and transite panels) have been qualified to PC-1. Interior partitions, systems and components are qualified to a mixture of PC-1 and PC-2.	N/A
0.2 System References	N/A Standards o DuPont Specifications 3027, 3017, 8728. o DuPont standard H16J, Flexible connections References System Design Descriptions (SDDs): o M-SYD-A-00021, HVAC System Design Description Air Balance Test Procedures (TPs): o TP-02-773A-BWING-01, Sec B Air Balance Test Procedure o TP-03-773A-CWING-01, Sec C Air Balance Test Procedure o 5Q1.2 Procedure 484, Building Air Survey Operator Round Sheets: o ROD-OPS-2002-002 - Control Area Operator (CAO) Round Sheets o ROD-OPS-2002-003 - Facility Operator (FO) Round Sheets Miscellaneous o SRNL-ROE-2007-00063, Table 4.3 submittal o WSRC-SA-2, Revision 3, February 2007, SRNL Technical Area Documented Safety Analysis (DSA) o WSRC-TS-97-00014, SRNL Technical Area (TA) Technical Safety Requirements (TSRs) Drawings o W156550, HV Roof Plan - Section B o ST4-11068, HV Ducting Plan - Sections B&C o W156551, HV Plan - Section C o ST5-11067, HV Roof Plan Details - Section B&C	N/A

	Evaluation Criteria	Discussion	Reference
		1 - Ventilation System – General Criteria	
1.1	Pressure differential should be maintained between zones and atmosphere.	Number of zones as credited by accident analysis to control hazardous material release; demonstrate by use considering potential in-leakage.	DOE-HDBK-1169 (2.2.9) ASHRAE Design Guide
		The Sections B&C restroom area HV (Exhaust) Systems help to maintain pressure differentials between the main floor service corridors and atmosphere. <u>Gap Analysis</u> No Gap - Proper DPs are assisted by the HV system fans.	
1.2	Materials of construction should be appropriate for normal, abnormal and accident conditions.	[DOE Guidance Document does not provide any specific evaluation guidance discussion for this criteria]	DOE-HDBK-1169 (2.2.5) ASME AG-1
		The Section B&C restroom area HV (Exhaust) systems are fabricated from 22 gauge galvanized steel. <u>Gap Analysis</u> No Gap - The materials of construction are appropriate for all conditions.	
1.3	Exhaust system should withstand anticipated normal, abnormal and accident system conditions and maintain confinement integrity.	As required by accident analysis to prevent accident release.	DOE-HDBK-1169 (2.4) ASHRAE Design Guide
		The Sections B&C restroom area HV (Exhaust) Systems help to maintain pressure differentials between the main floor service corridors and atmosphere. In the event of a power failure they would not be operable, however the partial shutdown of ventilation systems is addressed by operating procedures TO-06-011, Reduction/Restoration of C Section CHEX and TO-06-015, Reduction/Restoration of Section B CHEX. The HV Systems would not be directly impacted by the four relevant accident scenarios. <u>Gap Analysis</u> No Gap - Proper DPs are assisted by the HV system fans for all conditions.	
1.4	Confinement ventilation systems shall have appropriate filtration to minimize release.	Address: 1) Type of filter (e.g., HEPA, sand, sintered metal); 2) Filter sizing (flow capacity and pressure drop); 3) Decontamination Factor vs. accident analysis assumptions.	ASME AG-1 DOE-HDBK-1169 (2.2.1)
		The section B&C restroom area HV (Exhaust) systems are not HEPA filtered. <u>Gap Analysis</u> Gap Number 8: Discretionary Gap - The two B&C HV sub-systems do not have HEPA filtration.	

Evaluation Criteria	Discussion	Reference
	2 - Ventilation System – Instrumentation & Control	
2.1 Provide system status instrumentation and/or alarms.	Address key information to ensure system operability (e.g., system delta-P, filter pressure drop). The Sections B&C restroom area HV (Exhaust) systems (one fan per section) have neither ventilation status information nor alarms provided to the Control Area Operator (CAO) in the C041 Control Room. Gap Analysis Gap Number 9: Discretionary Gap - The two B/C-HV sub-systems do not have any local or remote system status instrumentation or alarms.	ASME AG-1 DOE-HDBK-1169 ASHRAE Design Guide (Section 4)
2.2 Interlock supply and exhaust fans to prevent positive pressure differential.	[DOE Guidance Document does not provide any specific evaluation guidance discussion for this criteria] The Sections B&C restroom area HV (Exhaust) system fans (one per section) are not interlocked with any of the main floor HVAC supply fans. Gap Analysis No Gap - These low volume HV fans are not expected to significantly impact the facility air balance under abnormal or accident conditions.	DOE-HDBK-1169 ASHRAE Design Guide (Section 4)
2.3 Post accident indication of filter break-through.	Instrumentation supports post accident planning and response; should be considered critical instrumentation for SC. The Sections B&C restroom area HV (Exhaust) systems discharge directely to the environment from the tertiary confinement zone. They do not have HEPA filters or any provision for exhaust air monitoring. Gap Analysis Gap Number 10: Discretionary Gap - Emission points from tertiary confinement zone do not have post accident indication of filter break through.	TECH-34

Evaluation Criteria	Discussion	Reference
2.4 Reliability of control system to maintain confinement function under normal, abnormal and accident conditions.	Address, for example, impacts of potential common mode failures from events that would require active confinement function. The Section B&C HV Systems are not expected to significantly impact the facility air balance under abnormal or accident conditions. All controls are local for the system are local except an automatice shutdown circuit interlocked with the diversion system controls. If a control system is added to close the gaps for criteria 2.1 it will have the required reliability to control the system. Gap Analysis Gap Number 9: Discretionary Gap - The two B/C-HV sub-systems do not have any local or remote system status instrumentation or alarms.	DOE-HDBK-1169 (2.4)
2.5 Control components should fail safe.	[DOE Guidance Document does not provide any specific evaluation guidance discussion for this criteria] The Sections B&C HV fan controls are fail safe and will continue to run if a control component fails while the fan is running. Gap Analysis No Gap - Control components for the Sections B&C HV systems are fail-safe.	DOE-HDBK-1169 (2.4)

Evaluation Criteria	Discussion	Reference
3 - Resistance to Internal Events – Fire		
3.1 Confinement ventilation systems should withstand credible fire events and be available to operate and maintain confinement.	Required for new facilities; as required by the accident analysis for existing facilities (discretionary). Must address protection of filter media.	DOE-HDBK-1169 (10.1) DOE-STD-1066
	As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Page 21 and 22 Discussion, the evaluation of internal fire events for an existing facility is only required if the accident analysis takes credit for the active confinement ventilation system.	
3.2 Confinement ventilation systems should not propagate spread of fire.	Required for new facilities; as required by the accident analysis for existing facilities (discretionary). Address fire barriers, fire dampers arrangement.	DOE-HDBK-1169 (10.1) DOE-STD-1066
	As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Page 21 and 22 Discussion, the evaluation of internal fire events for an existing facility is only required if the accident analysis takes credit for the active confinement ventilation system.	

Evaluation Criteria	Discussion	Reference
4 - Resistance to External Events – Natural Phenomena – Seismic		
4.1 Confinement ventilation systems should safely withstand earthquakes.	If the active CVS system is not credited in a seismic accident condition there is no need to evaluate that performance and/or design attribute for the confinement ventilation system (discretionary). Also, any seismic impact on the confinement ventilation system performance will be based on the current functional requirements in the DSA. NOTE: Seismic requirements may apply to Defense-in-Depth items indirectly for the protection of safety SSCs.	ASME AG-1 (AA) DOE O 420.1B DOE-HDBK-1169 (9.2)
	As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per 2004-2 Ventilation System Evaluation Guidance Addendum, March 6, 2007, Caution 4 and Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Page 22 Discussion, the evaluation of seismic events is only required if the accident analysis takes credit for the active confinement ventilation system during or after the NPH event.	

Evaluation Criteria	Discussion	Reference
	5 - Resistance to External Events – Natural Phenomena – Tornado/Wind	
5.1 Confinement ventilation systems should safely withstand tornado depressurization.	If the active CVS is not credited in a tornado condition there is no need to evaluate that performance and/or design attribute for the confinement ventilation system (discretionary). Also, any tornado impact on the confinement ventilation system performance will be based on the current functional requirements in the DSA.	DOE O 420.1B DOE-HDBK-1169 (9.2)
	As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per 2004-2 Ventilation System Evaluation Guidance Addendum, March 6, 2007, Caution 4 and Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Pages 22 and 23 Discussion, the evaluation of tornado and wind events is only required if the accident analysis takes credit for the active confinement ventilation system during or after the NPH event.	
5.2 Confinement ventilation systems should withstand design wind effects on system performance.	If the active CVS is not credited in a wind condition there is no need to evaluate that performance and/or design attribute for the confinement ventilation system (discretionary). Also, any wind impact on the confinement ventilation system performance will be based on the current NP analysis in the DSA.	DOE O 420.1B DOE-HDBK-1169 (9.2)
	As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per 2004-2 Ventilation System Evaluation Guidance Addendum, March 6, 2007, Caution 4 and Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Pages 22 and 23 Discussion, the evaluation of tornado and wind events is only required if the accident analysis takes credit for the active confinement ventilation system during or after the NPH event.	

	Evaluation Criteria	Discussion	Reference
		6 - Other NP Events (eg. flooding, precipitation)	
6.1	Confinement ventilation system should withstand other NP events considered credible in the DSA where the confinement ventilation system is credited.	If the active confinement ventilation system is not credited for this event there is no need to evaluate that performance and/or design attribute for the confinement ventilation system (discretionary). Also, any impact on the confinement ventilation system performance will be based on the current NP analysis in the DSA.	DOE O 420.1B DOE-HDBK-1169 (9.2)
		As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per 2004-2 Ventilation System Evaluation Guidance Addendum, March 6, 2007, Caution 4 and Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Page 23 Discussion, the evaluation of other NPH events is only required if the accident analysis takes credit for the active confinement ventilation system during or after the NPH event.	

Evaluation Criteria	Discussion	Reference
	7 - Range Fires / Dust Storms	
7.1 Administrative controls should be established to protect confinement ventilation systems from barrier threatening events.	Ensure appropriately thought out response to external threat is defined (e.g. pre-fire plan).	DOE O 420.1B
	The Savannah River Forestry Department is responsible for fire fighting efforts in regards to wildland fires. They also have a program of controlled burns and mechanical thinning of underbrush to limit or prevent wildland fires from spreading out of control. If the fire encroaches upon SRNL, the Savannah River Site Fire Department will direct extinguishing efforts. Building 773-A has a current Fire Pre Plan and has procedures to reduce confinement ventilation system air flow (originally developed for electrical system maintenance) that will minimize soot loading of the filters in the ventilation systems. Reference: AOP-06-007 <u>Gap Analysis</u> No Gap - Administrative controls are sufficient to protect the confinement ventilation systems from barrier threatening events.	

Evaluation Criteria	Discussion	Reference
	8 - Testability	
8.1 Design supports the periodic inspection and testing of filters and housing, and test and inspections are conducted periodically.	Ability to test for leakage per intent of N510. The Sections B&C restroom area HV (Exhaust) Systems do not have HEPA exhaust filters that can be tested. <u>Gap Analysis</u> No Gap - Periodic inspection and testing of HEPA filters will be indicated if HV HEPA filters are added.	DOE-HDBK-1169 (2.3.8) ASME AG-1 ASME N510
8.2 Instrumentation required to support system operability is calibrated.	Credited instrumentation should have specified calibration / surveillance requirements. Non-safety instrumentation should be calibrated as necessary to support system functionality. The Sections B&C restroom/area HV (Exhaust) systems has no instruments to calibrate. <u>Gap Analysis</u> No Gap	DOE-HDBK-1169 (2.3.8)
8.3 Integrated system performance testing is specified and performed.	Required responses assumed in the accident analysis must be periodically confirmed including any time constraints. The Sections B&C restroom/area HV (Exhaust) Systems have no integrated test requirements in the TSR. <u>Gap Analysis</u> No Gap - Sections B&C HV systems have no required integrated testing.	DOE-HDBK-1169 (2.3.8)

Evaluation Criteria	Discussion	Reference
	9 - Maintenance	
9.1 Filter service life program should be established.	Filter life (shelf life, service life, total life) expectancy should be determined. Consider: filter environment, maximum delta-P, radiological loading, age, and potential chemical exposure.	DOE-HDBK-1169 (3.1 & App C)
	The Sections B&C restroom area HV (Exhaust) Systems do not have HEPA exhaust filters. If HEPA filters are added under Gap for Criteria 1.4 they will be managed in accordance with Engineering Standard 15888 which is the basis of DOE-HDBK-1169 Appendix C. <u>Gap Analysis</u> No Gap - Sections B&C HV systems have no HEPA filters.	

Evaluation Criteria	Discussion	Reference
10 - Single Failure		
10.1 Failure of one component (equipment or control) shall not affect continuous operation.	Address potential failures (example failures - fan, backup power supply, switchgear).	DOE O 420.1B (Facility Safety, Chapter I, Sec. 3.b(8))
	The Sections B&C HV Systems are not expected to significantly impact the facility air balance under abnormal or accident conditions and have no installed backup components or power supplies. Gap Analysis Gap Number 11: Discretionary Gap - Two exhaust sub-systems are not provided with redundant fans..	
10.2 Automatic backup electrical power shall be provided to all critical instruments and equipment required to operate and monitor the confinement ventilation system.	[DOE Guidance Document does not provide any specific evaluation guidance discussion for this criteria]	DOE-HDBK-1169 (2.2.7)
	The Sections B&C restroom area HV (Exhaust) systems will not operate in the event of a power failure. Gap Analysis Gap Number 12: Discretionary Gap - The two B/C-HV sub-systems fans do not have automatic back-up power.	
10.3 Backup electrical power shall be provided to all critical instruments and equipment required to operate and monitor the confinement ventilation system.	NOTE: Safety Class is addressed through previous line.	DOE-HDBK-1169 (2.2.7)
	This evaluation criteria is NOT APPLICABLE, as it is an SS-only criteria. SRNL confinement ventilation systems are evaluated to SC criteria.	

Evaluation Criteria	Discussion	Reference
11 - Other Credited Functional Requirements		
11.1 Address any specific functional requirements for the confinement ventilation system (beyond the scope of those above) credited in the DSA.	[DOE Guidance Document does not provide any specific evaluation guidance discussion for this criteria]	10 CFR 830, Subpart B
	None <u>Gap Analysis</u> No Gap	

Evaluation Criteria	Discussion	Reference
0 - Ventilation System Description & References		
0.1 System Description	N/A <u>System Description</u> The Sections B&C Heating Ventilation and Air Conditioning (HVAC) Systems (Figure B) provide conditioned air to the offices and corridors (tertiary confinement zone) as well as directly into the labs. The system operates at 1/3 capacity on a loss of normal power or in CHEX diversion mode (supply air to offices only). The combined systems consist of 17 100% outside air units and a number of booster cooling units. The building framing, roof slabs and floor slabs have been qualified to PC-3. The building shell walls (windows and transite panels) have been qualified to PC-1. Interior partitions, systems and components are qualified to a mixture of PC-1 and PC-2.	N/A
0.2 System References	N/A <u>Standards</u> o DuPont Specifications 3027, 3017, 8728. o DuPont standard H16J, Flexible connections <u>References</u> System Design Descriptions (SDDs): o M-SYD-A-00001, HVAC System Design Description Air Balance Test Procedures (TPs): o TP-02-773A-BWING-01, Sec B Air Balance Test Procedure o TP-03-773A-CWING-01, Sec C Air Balance Test Procedure o 5Q1.2 Procedure 484, Building Air Survey Operator Round Sheets: o ROD-OPS-2002-002 - Control Area Operator (CAO) Round Sheets o ROD-OPS-2002-003 - Facility Operator (FO) Round Sheets Miscellaneous o SRNL-ROE-2007-00063, Table 4.3 submittal o WSRC-SA-2, Revision 3, February 2007, SRNL Technical Area Documented Safety Analysis (DSA) o WSRC-TS-97-00014, SRNL Technical Area (TA) Technical Safety Requirements (TSRs) Drawings o W156514 through W156517, HVAC Service Floor Ducting Plan - Section B o W156518 through W156521, HVAC Service Floor Ducting Plan - Section C	N/A

Evaluation Criteria	Discussion	Reference
	1 - Ventilation System – General Criteria	
1.1 Pressure differential should be maintained between zones and atmosphere.	Number of zones as credited by accident analysis to control hazardous material release; demonstrate by use considering potential in-leakage.	DOE-HDBK-1169 (2.2.9) ASHRAE Design Guide
	The Sections B&C zone flows and ventilation system interactions are described in the specific SDD documents (see references Section 0.2). Differential pressures (DPs) are not measured directly, but are maintained between zones by monitoring and balancing air flows. Periodic monitoring is conducted, including hood face velocities (Procedure 4Q/401) and air flow directions (Procedure 5Q1.2/484). Air balances are regularly conducted on all ventilation systems within a building section to verify facility design basis flows, as documented by the Sections B&C Air Balance test procedures (see references Section 0.2). Key system parameters are recorded on a daily and weekly basis (operator rounds listed in references Section 0.2) which allows monitoring of ventilation system function and performance. The HVAC Systems are designed to maintain the primary containment zones at a negative pressure with respect to surrounding areas such that a positive airflow is maintained into the primary confinement zones from the secondary confinement zones. Confinement Zones o Primary Confinement — Lab Hoods / Gloveboxes / Ducting through 1st testable HEPA filter stage o Secondary Confinement — Labs / Filter Rooms / Equipment Rooms / Service Corridor o Tertiary Confinement — Personnel Corridors / Offices / General Service Floor Area o Administrative Area — Sections A&D / Offices <u>Gap Analysis</u> No Gap - DPs are properly maintained under normal conditions.	
1.2 Materials of construction should be appropriate for normal, abnormal and accident conditions.	[DOE Guidance Document does not provide any specific evaluation guidance discussion for this criteria]	DOE-HDBK-1169 (2.2.5) ASME AG-1
	The Sections B&C HVAC (Supply Air) systems provide clean conditioned air to the building. Ducting is fabricated from 24 gauge galvanized steel and insulated where appropriate. Some insulation contains asbestos. Supply fans are fabricated from carbon steel. Flexible connections between fans and ducting or fans and casing are made of fabric collars. Collars are mounted over galvanized steel spool pieces with a maximum end to end gap of approximately 1". Fabric is non-burning neoprene attached to spool pieces with stainless steel bands. Seams are glued joints. <u>Gap Analysis</u> No Gap - Materials are appropriate for the expected service.	

Evaluation Criteria	Discussion	Reference
1.3 Exhaust system should withstand anticipated normal, abnormal and accident system conditions and maintain confinement integrity.	As required by accident analysis to prevent accident release.	DOE-HDBK-1169 (2.4) ASHRAE Design Guide
	The 773-A Building HVAC Systems consists of intake ducting, dampers, fans, filters banks, associated controls and instrumentation. During normal operation these multiple systems run continuously within defined performance parameters to maintain the proper containment air flow balance. The HVAC System components are adequate for normal and abnormal operation. Abnormal conditions include power failure, partial shutdown, or activation of the CHEX (Diversion Exhaust) system. In the event of a power failure, conditioned air will be supplied to clean areas only. All supply systems receiving outside air have freeze stats to automatically shut the fans down to prevent component damage due to freezing temperatures. Office and laboratory supply fans share a common outside inlet and windbox. Supply air (HVAC) fans that supply laboratory spaces have automatic dampers on the fan discharge that close if the fan is de-energized to prevent the possibility of the backflow of air from the laboratories to the inlet of the office supply fans. Partial shutdown of ventilation systems is addressed by operating procedures TO-06-011, Reduction/Restoration of C Section CHEX and TO-06-015, Reduction/Restoration of B Section CHEX. Activation of the CHEX Diversion system shuts down approximately 2/3rds of the Sections B&C supply air (HVAC) fans to insure that the facility air balance is maintained. The following accident scenarios are considered. Process Explosion - Unstable Lab Chemical or Accumulation of Process Flammable Gas or VOCs with no consequential fire - Ventilation systems would operate normally to maintain a positive pressure differential into the effected lab. Explosion - Glovebox Overpressurization - same as above. Explosion - Accumulation of Distributed Flammable Gas with no consequential fire - same as above. Drop / Spill - Ventilation systems would operate normally to draw lab/cell air towards hoods. Normal room infiltration would contain the spill to the effected lab/cell. If the exhaust system HEPA filter plugs, the contaminants would be contained within the lab and ductwork. If the HEPA is compromised and contamination is detected in the B or C stack, the Diversion system would be placed in service to direct exhaust air to the Sand Filter. If filter housings or ducting are compromised, the RREX systems would contain the contamination. <u>Gap Analysis</u> Gap Number 2: Discretionary Gap - Isolation dampers are not provided to isolate individual portions of the supply system. Note: Also see 773-A Sections B&C CHEX and 773-A Sections B&C PHEX.	

Evaluation Criteria	Discussion	Reference
1.4 Confinement ventilation systems shall have appropriate filtration to minimize release.	Address: 1) Type of filter (e.g., HEPA, sand, sintered metal); 2) Filter sizing (flow capacity and pressure drop); 3) Decontamination Factor vs. accident analysis assumptions. The Sections B&C HVAC (Supply Air) systems have replaceable blanket filters, installed to filter incoming supply air. <u>Gap Analysis</u> No Gap - Sections B&C HVAC systems do not have HEPA filtration.	ASME AG-1 DOE-HDBK-1169 (2.2.1)

Evaluation Criteria	Discussion	Reference
2 - Ventilation System – Instrumentation & Control		
2.1 Provide system status instrumentation and/or alarms.	Address key information to ensure system operability (e.g., system delta-P, filter pressure drop).	ASME AG-1 DOE-HDBK-1169 ASHRAE Design Guide (Section 4)
	The Sections B&C HVAC (Supply Air) systems (about 17 fans per section) have neither status information nor alarms provided to the Control Area Operator (CAO) in the C041 Control Room (CR). <u>Gap Analysis</u> Gap Number 13: Discretionary Gap - The B/C HVAC systems do not have any remote system status instrumentation, control or alarms. Gap Number 14: Discretionary Gap - There is no ΔP measurement between the atmosphere and the tertiary confinement zones.	
2.2 Interlock supply and exhaust fans to prevent positive pressure differential.	[DOE Guidance Document does not provide any specific evaluation guidance discussion for this criteria]	DOE-HDBK-1169 ASHRAE Design Guide (Section 4)
	The Sections B&C HVAC (Supply Air) system fans (about 17 per section) are not interlocked with their CHEX and PHEX fan counterparts. <u>Gap Analysis</u> Gap Number 3: Discretionary Gap - Interlocks are not provided between the supply and exhaust systems. Note: Also see 773-A Sections B&C CHEX and 773-A Sections B&C PHEX	
2.3 Post accident indication of filter break-through.	Instrumentation supports post accident planning and response; should be considered critical instrumentation for SC.	TECH-34
	The Sections B&C HVAC (Supply Air) systems are not impacted by the accident scenarios related to exhaust filter break-through. <u>Gap Analysis</u> No Gap - Sections B&C HVAC systems do not have exhaust filters where breakthrough would occur.	

Evaluation Criteria	Discussion	Reference
2.4 Reliability of control system to maintain confinement function under normal, abnormal and accident conditions.	Address, for example, impacts of potential common mode failures from events that would require active confinement function.	DOE-HDBK-1169 (2.4)
	Abnormal conditions include power failure, partial shutdown, or activation of the Diversion system. In the event of a power failure, conditioned air will be supplied to clean areas only (Sections B & C main floor offices and one Section B service floor mezzanine). Office and laboratory supply fans share a common outside inlet. All supply systems receiving outside air have freeze stats to automatically shut the fans down to prevent component damage due to freezing temperatures. Supply fans that supply laboratory spaces have automatic dampers on the fan discharge that close if the fan is de-energized to prevent the possibility of the backflow of air from the laboratories to the inlet of the office supply fans. HVAC systems do not have installed backup systems. Partial shutdown of ventilation systems is addressed by operating procedures TO-06-011, Reduction/Restoration of Section C CHEX and TO-06-015, Reduction/Restoration of Section B CHEX. Activation of the Diversion system shuts down approximately 2/3rds of the Sections B&C Supply fans to insure that the facility air balance is maintained. Procedures control Lab Operations during abnormal conditions. Possible abnormal condition would be loss of steam reheat during periods of high humidity. This could result in condensation within confinement ducting, possibly wetting the HEPA filters which may reduce airflow and may result in contamination wicking through the filter media. Under the four accident scenarios, the Supply air HVAC systems would function normally. The Sections B&C HVAC supply air system fans are periodically monitored by Operations personnel on their rounds during normal conditions. System flow manipulations during all operating conditions are locally made at each fan according to Abnormal Operating Procedures (AOPs) and Emergency Operating Procedures (EOPs). <u>Gap Analysis</u> Gap Number 13: Discretionary Gap - The B/C HVAC systems do not have any remote system status instrumentation, control or alarms. Note: Also see B/C-HVAC Criteria 2.1.	
2.5 Control components should fail safe.	[DOE Guidance Document does not provide any specific evaluation guidance discussion for this criteria]	DOE-HDBK-1169 (2.4)
	All control equipment for the Sections B & C HVAC systems are designed to be fail safe. Automatic discharge dampers are not installed and/or operational on all of the lab supply fans to consistently close on loss of normal power. <u>Gap Analysis</u> Gap Number 2: Discretionary Gap - Isolation dampers are not provided to isolate individual portions of the supply system.	

Evaluation Criteria	Discussion	Reference
3 - Resistance to Internal Events – Fire		
3.1 Confinement ventilation systems should withstand credible fire events and be available to operate and maintain confinement.	Required for new facilities; as required by the accident analysis for existing facilities (discretionary). Must address protection of filter media.	DOE-HDBK-1169 (10.1) DOE-STD-1066
	As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Page 21 and 22 Discussion, the evaluation of internal fire events for an existing facility is only required if the accident analysis takes credit for the active confinement ventilation system.	
3.2 Confinement ventilation systems should not propagate spread of fire.	Required for new facilities; as required by the accident analysis for existing facilities (discretionary). Address fire barriers, fire dampers arrangement.	DOE-HDBK-1169 (10.1) DOE-STD-1066
	As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Page 21 and 22 Discussion, the evaluation of internal fire events for an existing facility is only required if the accident analysis takes credit for the active confinement ventilation system.	

Evaluation Criteria	Discussion	Reference
4 - Resistance to External Events – Natural Phenomena – Seismic		
4.1 Confinement ventilation systems should safely withstand earthquakes.	If the active CVS system is not credited in a seismic accident condition there is no need to evaluate that performance and/or design attribute for the confinement ventilation system (discretionary). Also, any seismic impact on the confinement ventilation system performance will be based on the current functional requirements in the DSA. NOTE: Seismic requirements may apply to Defense-in-Depth items indirectly for the protection of safety SSCs.	ASME AG-1 (AA) DOE O 420.1B DOE-HDBK-1169 (9.2)
	As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per 2004-2 Ventilation System Evaluation Guidance Addendum, March 6, 2007, Caution 4 and Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Page 22 Discussion, the evaluation of seismic events is only required if the accident analysis takes credit for the active confinement ventilation system during or after the NPH event.	

	Evaluation Criteria	Discussion	Reference
		5 - Resistance to External Events – Natural Phenomena – Tornado/Wind	
5.1	Confinement ventilation systems should safely withstand tornado depressurization.	If the active CVS is not credited in a tornado condition there is no need to evaluate that performance and/or design attribute for the confinement ventilation system (discretionary). Also, any tornado impact on the confinement ventilation system performance will be based on the current functional requirements in the DSA.	DOE O 420.1B DOE-HDBK-1169 (9.2)
		As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per 2004-2 Ventilation System Evaluation Guidance Addendum, March 6, 2007, Caution 4 and Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Pages 22 and 23 Discussion, the evaluation of tornado and wind events is only required if the accident analysis takes credit for the active confinement ventilation system during or after the NPH event.	
5.2	Confinement ventilation systems should withstand design wind effects on system performance.	If the active CVS is not credited in a wind condition there is no need to evaluate that performance and/or design attribute for the confinement ventilation system (discretionary). Also, any wind impact on the confinement ventilation system performance will be based on the current NP analysis in the DSA.	DOE O 420.1B DOE-HDBK-1169 (9.2)
		As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per 2004-2 Ventilation System Evaluation Guidance Addendum, March 6, 2007, Caution 4 and Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Pages 22 and 23 Discussion, the evaluation of tornado and wind events is only required if the accident analysis takes credit for the active confinement ventilation system during or after the NPH event.	

	Evaluation Criteria	Discussion	Reference
		6 - Other NP Events (eg. flooding, precipitation)	
6.1	Confinement ventilation system should withstand other NP events considered credible in the DSA where the confinement ventilation system is credited.	If the active confinement ventilation system is not credited for this event there is no need to evaluate that performance and/or design attribute for the confinement ventilation system (discretionary). Also, any impact on the confinement ventilation system performance will be based on the current NP analysis in the DSA.	DOE O 420.1B DOE-HDBK-1169 (9.2)
		As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per 2004-2 Ventilation System Evaluation Guidance Addendum, March 6, 2007, Caution 4 and Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Page 23 Discussion, the evaluation of other NPH events is only required if the accident analysis takes credit for the active confinement ventilation system during or after the NPH event.	

	Evaluation Criteria	Discussion	Reference
		7 - Range Fires / Dust Storms	
7.1	Administrative controls should be established to protect confinement ventilation systems from barrier threatening events.	Ensure appropriately thought out response to external threat is defined (e.g. pre-fire plan).	DOE O 420.1B
		The Savannah River Forestry Department is responsible for fire fighting efforts in regards to wildland fires. They also have a program of controlled burns and mechanical thinning of underbrush to limit or prevent wildland fires from spreading out of control. If the fire encroaches upon SRNL, the Savannah River Site Fire Department will direct extinguishing efforts. Building 773-A has a current Fire Pre Plan and has procedures to reduce confinement ventilation system air flow (originally developed for electrical system maintenance) that will minimize soot loading of the filters in the ventilation systems. Reference: AOP-06-007 Gap Analysis No Gap - Administrative controls are sufficient to protect the confinement ventilation systems from barrier threatening events.	

Evaluation Criteria	Discussion	Reference
8 - Testability		
8.1 Design supports the periodic inspection and testing of filters and housing, and test and inspections are conducted periodically.	Ability to test for leakage per intent of N510.	DOE-HDBK-1169 (2.3.8) ASME AG-1 ASME N510
	Sections B&C HVAC supply fan windbox prefilters are changed out periodically (at least annually). Main and Service Floor door and wall register prefilters are changed on frequencies ranging from semiannual to annual. There are no in-service inspection requirements. <u>Gap Analysis</u> No Gap - Sections B&C HVAC systems have no testable or inspectable exhaust filters.	
8.2 Instrumentation required to support system operability is calibrated.	Credited instrumentation should have specified calibration / surveillance requirements. Non-safety instrumentation should be calibrated as necessary to support system functionality. The Sections B&C HVAC (Supply Air) systems have no calibration requirements in the TSR. Non-safety instrumentation is calibrated on an as-needed basis. <u>Gap Analysis</u> No Gap - Sections B&C HVAC systems have no calibration requirements.	DOE-HDBK-1169 (2.3.8)
8.3 Integrated system performance testing is specified and performed.	Required responses assumed in the accident analysis must be periodically confirmed including any time constraints.	DOE-HDBK-1169 (2.3.8)
	The Sections B&C HVAC (Supply Air) systems have no requirements in the TSR for integrated system performance testing. Testing of the interlocks between the HVAC system and CHEX Diversion system are not credited in the accident analysis but is tested on a periodic basis as part of the CHEX Diversion system integrated testing. <u>Gap Analysis</u> No Gaps	

Evaluation Criteria	Discussion	Reference
9 - Maintenance		
9.1 Filter service life program should be established.	Filter life (shelf life, service life, total life) expectancy should be determined. Consider: filter environment, maximum delta-P, radiological loading, age, and potential chemical exposure. Sections B&C HVAC units do not use HEPA filters. A service life program is not required. Gap Analysis No Gap - Sections B&C HVAC systems do not use HEPA filters.	DOE-HDBK-1169 (3.1 & App C)

Evaluation Criteria	Discussion	Reference
	10 - Single Failure	
10.1 Failure of one component (equipment or control) shall not affect continuous operation.	Address potential failures (example failures - fan, backup power supply, switchgear). The Sections B&C HVAC (Supply Air) systems include approximately 17 fans each. It is unlikely that more than a 2 or 3 of these fans might fail at the same time. Procedures are established and in place to identify these failures and to implement mitigating actions. In the event of a power failure, the office supply fans, providing air flow to the main floor of Sections B&C, and one service floor supply fan will operate on standby power. <u>Gap Analysis</u> No Gap - No single failure in the Sections B&C HVAC systems will prevent critical confinement equipment from operating.	DOE O 420.1B (Facility Safety, Chapter I, Sec. 3.b(8))
10.2 Automatic backup electrical power shall be provided to all critical instruments and equipment required to operate and monitor the confinement ventilation system.	[DOE Guidance Document does not provide any specific evaluation guidance discussion for this criteria] In the event of a power failure, the office supply fans providing air flow to the main floor of Sections B&C and to one service floor supply fan will operate on standby power from a diesel generator. All other fans will not operate. <u>Gap Analysis</u> No Gap - No single fan failure in the Sections B&C HVAC systems will prevent normal operation. A power failure will still permit key confinement ventilation HVAC fans to operate on standby power.	DOE-HDBK-1169 (2.2.7)
10.3 Backup electrical power shall be provided to all critical instruments and equipment required to operate and monitor the confinement ventilation system.	NOTE: Safety Class is addressed through previous line. This evaluation criteria is NOT APPLICABLE, as it is an SS-only criteria. SRNL confinement ventilation systems are evaluated to SC criteria.	DOE-HDBK-1169 (2.2.7)

Evaluation Criteria	Discussion	Reference
11 - Other Credited Functional Requirements		
11.1 Address any specific functional requirements for the confinement ventilation system (beyond the scope of those above) credited in the DSA.	[DOE Guidance Document does not provide any specific evaluation guidance discussion for this criteria]	10 CFR 830, Subpart B
	None <u>Gap Analysis</u> No Gap	

Evaluation Criteria	Discussion	Reference
0 - Ventilation System Description & References		
0.1 System Description	N/A System Description The Off-Gas Exhaust (OGE) system serves gloveboxes and other special process enclosures equipped with inlet and outlet HEPA filters. Two interconnected OGE sub-systems service Sections B, C and F. Each sub-system has a normal and standby two stage HEPA filter housing, a normal and standby exhaust fan on diesel generator power and discharge to the SRNL Sand Filter. See Figure A. The building framing, roof slabs and floor slabs have been qualified to PC-3. The building shell walls (windows and transite panels) have been qualified to PC-1. Interior partitions, systems and components are qualified to a mixture of PC-1 and PC-2.	N/A
0.2 System References	N/A Standards o DuPont Specifications 3027, 3017, 8728. o M-SPP-G-00243, HEPA Filter Specification o SRS Engineering Standard 15888, HEPA Filter Requirements o ANSI/ASME NQA-1, Quality Assurance Program Requirements for Nuclear Facilities, 1997 o DOE-STD-3020-2005, DOE Technical Standard - Specification for HEPA Filters Used by DOE Contractors o DOE-STD-3025-2007, DOE Technical Standard - Quality Assurance Inspection and Testing of HEPA Filters o UL 586, UL Standard for Safety, High Efficiency, Particulate, Air Filter Units, 1996. References System Design Descriptions (SDDs): o M-SYD-A-00002, Off Gas Exhaust (OGE) System Design Description Operator Round Sheets: o ROD-OPS-2002-002 - Control Area Operator (CAO) Round Sheets o ROD-OPS-2002-003 - Facility Operator (FO) Round Sheets Miscellaneous o SRNL-ESD-2007-00017, Structural Integrity Program Scope, Resources & Estimate, 02/07/07 o SRNL-ROE-2007-00063, Table 4.3 submittal o WSRC-SA-2, Revision 3, February 2007, SRNL Technical Area Documented Safety Analysis (DSA) o WSRC-TS-97-00014, SRNL Technical Area (TA) Technical Safety Requirements (TSRs) Drawings o M-M6-A-0193 - Section B OGE P&ID Sheet 1 of 3 o M-M6-A-0194 - Section B OGE P&ID Sheet 2 of 3 o M-M6-A-0195 - Section B OGE P&ID Sheet 3 of 3 o M-M6-A-0197 - Section C OGE P&ID Sheet 1 of 4 o M-M6-A-0198 - Section C OGE P&ID Sheet 2 of 4 o M-M6-A-0212 - Section C OGE P&ID Sheet 3 of 4 o M-M6-A-0199 - Section C OGE P&ID Sheet 4 of 4 o M-M6-A-0200 - Section F OGE P&ID	N/A

Evaluation Criteria	Discussion	Reference
1 - Ventilation System – General Criteria		
1.1 Pressure differential should be maintained between zones and atmosphere.	Number of zones as credited by accident analysis to control hazardous material release; demonstrate by use considering potential in-leakage. <u>Confinement Zones</u> • Primary Confinement — Gloveboxes, Intermediate Level Cells and Vacuum Pump Boxes • Secondary Confinement — Labs containing gloveboxes and associated mechanical rooms • Tertiary Confinement — Building exterior shell including Offices, Corridors and General Support Areas around Lab Modules and mechanical spaces The Off-Gas Exhaust (OGE) system serves gloveboxes and Intermediate Level Cells (ILCs) - tightly sealed process enclosures that handle corrosive chemicals and radiological materials, and which are equipped with inlet and outlet HEPA filters. These enclosures serve as the primary confinement zone boundary. Secondary and tertiary confinement zones are maintained by other ventilation exhaust systems. Those gloveboxes that contain inventories above Hazard Category 3 thresholds of DOE-STD-1027-92 are credited as follows: • Provide a passive confinement function that isolates radioactive materials from the facility workers (SS function). • Provide a passive confinement function that allows the Off-Gas Exhaust System to sweep the glovebox of any process flammable gases to prevent a flammable gas explosion (SS function). Facility gloveboxes are administratively maintained at a vacuum of 0.5 to 1.0 in. wc vacuum relative to the surrounding space. The OGE system fans have abundant capacity to induce an inward air flow in the event of an open gloveport or passthrough in order to protect facility workers. <u>Gap Analysis</u> No Gap.	DOE-HDBK-1169 (2.2.9) ASHRAE Design Guide
1.2 Materials of construction should be appropriate for normal, abnormal and accident conditions.	[DOE Guidance Document does not provide any specific evaluation guidance discussion for this criteria] The OGE system ductwork is fabricated from stainless steel pipe, either grade 304 LC (low carbon) or grade 347 . The material was selected to be resistant to corrosion resulting from chemical fumes, an anticipated effluent of laboratory gloveboxes. System dampers are also constructed from stainless steel with chemically resistant valve trim. The filter housings are also constructed from grade 304 stainless steel and use neoprene gaskets for chemical resistance. The system fans are constructed from carbon steel with applied protective coatings. Recent ultrasonic pipe thickness measurements on the OGE main exhaust headers indicated that the original wall thickness has negligible degradation from corrosion. <u>Gap Analysis</u> No Gap.	DOE-HDBK-1169 (2.2.5) ASME AG-1

Evaluation Criteria	Discussion	Reference
1.3 Exhaust system should withstand anticipated normal, abnormal and accident system conditions and maintain confinement integrity.	As required by accident analysis to prevent accident release. The OGE system facilitates the confinement feature of the facility gloveboxes. The system is of large physical size spanning many areas of the building, such that one local accident event would not have an overall effect on the system operation. The system is not credited in the DSA with surviving an NPH (earthquake) event . The HEPA filter housings are located in a dedicated filter room which is segregated from the common accident initiator (flammable gas). The HEPA filter housings are a totally enclosed design. Process flammable gas generated in an individual glovebox would be diluted many times below the lower flammable limit prior to entering the filter housing. Thus an explosion involving the OGE filter housing is not credible. Furthermore, the OGE filters do not constitute the final filtration boundary prior to release to the environment. The OGE system discharges to the SRNL Sand Filter offering defense-in-depth protection. <u>Gap Analysis</u> No Gap.	DOE-HDBK-1169 (2.4) ASHRAE Design Guide
1.4 Confinement ventilation systems shall have appropriate filtration to minimize release.	Address: 1) Type of filter (e.g., HEPA, sand, sintered metal); 2) Filter sizing (flow capacity and pressure drop); 3) Decontamination Factor vs. accident analysis assumptions. The OGE effluent is filtered by two stages of individually tested HEPA filters in series. Prior to receipt the filters are tested at the Independent Filter Testing Facility (FTF) to confirm an efficiency of at least 99.97% for a decontamination factor DF = 3333. Decontamination factor has not been considered in the facility DSA. The filters are credited with confinement function only, not dose reduction. A second set of redundant filters are installed in parallel as a standby exhaust path. Each HEPA filter bank is preceded by a 304 stainless steel moisture separator that also serves as a pre filter. The HEPA filters are Flanders size GG-F (24x24x11.5) gel-seal filters rated for 1500 cfm at 1.3 in.w.c. maximum initial pressure drop, which is adequate for the maximum rated OGE fan capacity of 1100 cfm. Gloveboxes and ILCs are equipped with outlet HEPA filters to minimize material build-up in the exhaust system ductwork. Gloveboxes and ILCs are also equipped with inlet HEPA filters. <u>Gap Analysis</u> No Gap.	ASME AG-1 DOE-HDBK-1169 (2.2.1)

Evaluation Criteria	Discussion	Reference
2 - Ventilation System – Instrumentation & Control		
2.1 Provide system status instrumentation and/or alarms.	Address key information to ensure system operability (e.g., system delta-P, filter pressure drop).	ASME AG-1 DOE-HDBK-1169 ASHRAE Design Guide (Section 4)
	Differential pressure gauges are installed to measure room to glovebox DP for all facility gloveboxes. Each of the two parallel filter trains in the OGE main HEPA filter bank has installed differential pressure instrumentation to measure filter housing DP on a routine basis, and to measure individual HEPA filter DP on an as-needed basis. Each OGE sub-system has installed flow instrumentation indicating total exhaust airflow rate. Exhaust air temperature indication is not required. The system handles ambient, conditioned air exhausted from the laboratory rooms via the gloveboxes. A pressure indicator is installed on each OGE sub-system to measure system static pressure. These pressure indicators are monitored daily as a TSR surveillance requirement. A local transmitter installed in each OGE sub-system also sends a pressure signal to the control room for separate indication and to activate a low vacuum alarm. <u>Gap Analysis</u> Gap Number 19: Discretionary Gap - Not all glovebox are provided with outlet HEPA filter ΔP instrumentation. Gap Number 20: Discretionary Gap - Not all gloveboxes are provided with exhaust flow rate instrumentation.	
2.2 Interlock supply and exhaust fans to prevent positive pressure differential.	[DOE Guidance Document does not provide any specific evaluation guidance discussion for this criteria]	DOE-HDBK-1169 ASHRAE Design Guide (Section 4)
	The Off-Gas System is not equipped with a supply fan. <u>Gap Analysis</u> No Gap.	
2.3 Post accident indication of filter break-through.	Instrumentation supports post accident planning and response; should be considered critical instrumentation for SC.	TECH-34
	The OGE system effluent is monitored by an isokinetic sampling system and a Stack Air Activity Alarm system at the discharge of the SRNL Sand Filter that reports to the Control Room. The air at the inlet to the SRNL Sand Filter is also monitored and alarmed in the Control Room. <u>Gap Analysis</u> No Gaps	

Evaluation Criteria	Discussion	Reference
2.4 Reliability of control system to maintain confinement function under normal, abnormal and accident conditions.	Address, for example, impacts of potential common mode failures from events that would require active confinement function.	DOE-HDBK-1169 (2.4)
	The accidents evaluated by this report are as follows: Explosion - Glovebox Overpressurization Explosion - Distributed Flammable Gas Drop / Spill Process Explosion - Unstable Lab Chemical or Process Flammable Gas or VOCs The relevant accident for the OGE system is Explosion - Glovebox Overpressurization. From the facility DSA accident analysis - "Expansion volume cylinders, gas cylinders, positive displacement pumps, or other lab equipment etc., explosive/ pyrophoric material explodes inside glovebox resulting in breach of contaminated boundaries. The active ventilation feature of the OGE system is expected to remain operable following a glovebox breach. An open gloveport caused by a breached glove is an anticipated event, and the OGE system is expected to continue to prevent the release of the glovebox contents following this event. An explosion causing a breached glovebox would have negligible effect on the system fans and filters, because this equipment is located in fan and filter rooms respectively, a significant distance from the glovebox laboratory modules. Glovebox exhaust is typically transported by small bore pipe which connects to the main exhaust header, fabricated from large bore schedule 10 pipe. This provides a robust system which is resistant to damaging pressure waves emanating from a glovebox explosion that are dissipated over the long pipe run to reach the HEPA filter housing. The system has redundant, parallel HEPA filters to enhance post accident reliability. The two OGE fans are aligned as one operating, one in standby to provide redundancy. The fans are operated from the control room. Each fan has an automatic discharge damper to prevent backflow through the idle fan. The OGE fans are provided with standby power feed to continue operation following a failure of normal power. <u>Gap Analysis</u> No Gap.	
2.5 Control components should fail safe.	[DOE Guidance Document does not provide any specific evaluation guidance discussion for this criteria]	DOE-HDBK-1169 (2.4)
	The OGE fans are controlled from the facility control room. In the case of fan failure, the associated discharge damper closes automatically to preclude backflow as the standby fan is placed in service. Operation of the fans is not credited in the DSA. <u>Gap Analysis</u> Gap Number 21: Discretionary Gap - Failure of online fan does not automatically start the Standby fan.	

Evaluation Criteria	Discussion	Reference
3 - Resistance to Internal Events – Fire		
3.1 Confinement ventilation systems should withstand credible fire events and be available to operate and maintain confinement.	Required for new facilities; as required by the accident analysis for existing facilities (discretionary). Must address protection of filter media.	DOE-HDBK-1169 (10.1) DOE-STD-1066
	As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Page 21 and 22 Discussion, the evaluation of internal fire events for an existing facility is only required if the accident analysis takes credit for the active confinement ventilation system.	
3.2 Confinement ventilation systems should not propagate spread of fire.	Required for new facilities; as required by the accident analysis for existing facilities (discretionary). Address fire barriers, fire dampers arrangement.	DOE-HDBK-1169 (10.1) DOE-STD-1066
	As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Page 21 and 22 Discussion, the evaluation of internal fire events for an existing facility is only required if the accident analysis takes credit for the active confinement ventilation system.	

Evaluation Criteria	Discussion	Reference
4 - Resistance to External Events – Natural Phenomena – Seismic		
4.1 Confinement ventilation systems should safely withstand earthquakes.	If the active CVS system is not credited in a seismic accident condition there is no need to evaluate that performance and/or design attribute for the confinement ventilation system (discretionary). Also, any seismic impact on the confinement ventilation system performance will be based on the current functional requirements in the DSA. NOTE: Seismic requirements may apply to Defense-in-Depth items indirectly for the protection of safety SSCs.	ASME AG-1 (AA) DOE O 420.1B DOE-HDBK-1169 (9.2)
	As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per 2004-2 Ventilation System Evaluation Guidance Addendum, March 6, 2007, Caution 4 and Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Page 22 Discussion, the evaluation of seismic events is only required if the accident analysis takes credit for the active confinement ventilation system during or after the NPH event.	

	Evaluation Criteria	Discussion	Reference
		5 - Resistance to External Events – Natural Phenomena – Tornado/Wind	
5.1	Confinement ventilation systems should safely withstand tornado depressurization.	If the active CVS is not credited in a tornado condition there is no need to evaluate that performance and/or design attribute for the confinement ventilation system (discretionary). Also, any tornado impact on the confinement ventilation system performance will be based on the current functional requirements in the DSA. As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per 2004-2 Ventilation System Evaluation Guidance Addendum, March 6, 2007, Caution 4 and Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Pages 22 and 23 Discussion, the evaluation of tornado and wind events is only required if the accident analysis takes credit for the active confinement ventilation system during or after the NPH event.	DOE O 420.1B DOE-HDBK-1169 (9.2)
5.2	Confinement ventilation systems should withstand design wind effects on system performance.	If the active CVS is not credited in a wind condition there is no need to evaluate that performance and/or design attribute for the confinement ventilation system (discretionary). Also, any wind impact on the confinement ventilation system performance will be based on the current NP analysis in the DSA. As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per 2004-2 Ventilation System Evaluation Guidance Addendum, March 6, 2007, Caution 4 and Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Pages 22 and 23 Discussion, the evaluation of tornado and wind events is only required if the accident analysis takes credit for the active confinement ventilation system during or after the NPH event.	DOE O 420.1B DOE-HDBK-1169 (9.2)

	Evaluation Criteria	Discussion	Reference
		6 - Other NP Events (eg. flooding, precipitation)	
6.1	Confinement ventilation system should withstand other NP events considered credible in the DSA where the confinement ventilation system is credited.	If the active confinement ventilation system is not credited for this event there is no need to evaluate that performance and/or design attribute for the confinement ventilation system (discretionary). Also, any impact on the confinement ventilation system performance will be based on the current NP analysis in the DSA.	DOE O 420.1B DOE-HDBK-1169 (9.2)
		As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per 2004-2 Ventilation System Evaluation Guidance Addendum, March 6, 2007, Caution 4 and Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Page 23 Discussion, the evaluation of other NPH events is only required if the accident analysis takes credit for the active confinement ventilation system during or after the NPH event.	

Evaluation Criteria	Discussion	Reference
	7 - Range Fires / Dust Storms	
7.1 Administrative controls should be established to protect confinement ventilation systems from barrier threatening events.	Ensure appropriately thought out response to external threat is defined (e.g. pre-fire plan).	DOE O 420.1B
	The Savannah River Forestry Department is responsible for fire fighting efforts in regards to wildland fires. They also have a program of controlled burns and mechanical thinning of underbrush to limit or prevent wildland fires spreading out of control. If the fire encroaches upon SRNL, the Savannah River Site Fire Department will direct extinguishing efforts. Building 773-A has a current Fire Pre Plan and has procedures to reduce confinement ventilation system air flow (originally develop for electrical system maintenance) that will minimize soot loading of the filters in the ventilation systems. Reference: AOP-06-007 <u>Gap Analysis</u> No Gap. Administrative controls are sufficient to protect the confinement ventilation systems for barrier threatening events.	

Evaluation Criteria	Discussion	Reference
	8 - Testability	
8.1 Design supports the periodic inspection and testing of filters and housing, and test and inspections are conducted periodically.	Ability to test for leakage per intent of N510. The OGE system HEPA filter housings are totally enclosed bag-in/bag-out units with gel-seal technology. The filter housing has all of the features prescribed in ASME N510, Section 10 to facilitate in-place HEPA filter testing, i.e injection ports and sample ports to support HEPA filter aerosol testing. In-place leak testing of HEPA filter installation is performed in accordance with Manual 2Y1 "HEPA Filter Testing Procedures", Procedure 104 "General Surveillance Testing of HEPA Filters". In-place leak testing is performed at scheduled intervals for installed testable HEPA filter systems to detect deterioration of filters, gaskets or other causes that could result in leaks. The facility has established a TSR surveillance requirement to perform in place aerosol testing of the HEPA filters at 18 month intervals. <u>Gap Analysis</u> No Gap.	DOE-HDBK-1169 (2.3.8) ASME AG-1 ASME N510
8.2 Instrumentation required to support system operability is calibrated.	Credited instrumentation should have specified calibration / surveillance requirements. Non-safety instrumentation should be calibrated as necessary to support system functionality. DSA-credited instrumentation consists of the Section B/F OGE Header Pressure Indicator and the Section C OGE Header Pressure Indicator, which are classified as Safety Significant. These instruments sense the exhaust header static pressure (vacuum) which provides the credited indication of OGE airflow required to sweep flammable gases from the gloveboxes in Sections B, F and C. The DSA requires these instruments to be calibrated and tested periodically to verify accuracy and operability. The TSR contains a surveillance requirement to calibrate these instruments every 18 months. The TSR Linking Document specifies facility procedure TE-48-043, "(TSR) Functional Check of B & C OGE Pressure Indicators" to perform the calibration. Additional non-DSA credited OGE system instrumentation is calibrated at less frequent intervals. <u>Gap Analysis</u> No Gap.	DOE-HDBK-1169 (2.3.8)

Evaluation Criteria	Discussion	Reference
8.3 Integrated system performance testing is specified and performed.	Required responses assumed in the accident analysis must be periodically confirmed including any time constraints. The operating and standby OGE fans are interchanged monthly using an approved operating procedure. The system static pressure is monitored twice daily by the facility operator round sheets. Each glovebox served by the system is monitored locally for specified operating differential pressure prior to and during use by laboratory personnel. No additional integrated system performance testing for the OGE system is currently done because these actions provide frequent indication of adequate performance. Gap Analysis No Gap	DOE-HDBK-1169 (2.3.8)

Evaluation Criteria	Discussion	Reference
9 - Maintenance		
9.1 Filter service life program should be established.	Filter life (shelf life, service life, total life) expectancy should be determined. Consider: filter environment, maximum delta-P, radiological loading, age, and potential chemical exposure.	DOE-HDBK-1169 (3.1 & App C)
	HEPA filter life expectancy is determined according to SRS Site Standard 15888, "HEPA Filter Requirements". The maximum allowable life (shelf life + in-service life) of a HEPA filter used at SRS shall not exceed 10 years. The system HEPA filters are replaced at an interval within the 10 year guideline. Periodic in-place leak tests are performed to ensure that the filters are fulfilling their confinement function. The filters must meet the leak test acceptance criteria to be placed/remain in service. Filter environment is considered. The OGE filters handle glovebox exhaust. Air drawn into the gloveboxes is ambient temperature indoor conditioned air with a relative humidity ~ 50%. Therefore moisture accumulation that will adversely affect the filter media is not expected. Additionally, the filter housing is equipped with demisters at the inlet. Moisture laden filters are replaced when discovered. Glovebox inlet and outlet HEPA filters (non-testable) are replaced at more frequent intervals based on the severity of the service of the specific glovebox. Those exposed to moisture or chemicals are replaced after a shorter service life. <u>Gap Analysis</u> No Gap	

Evaluation Criteria	Discussion	Reference
	10 - Single Failure	
10.1 Failure of one component (equipment or control) shall not affect continuous operation.	Address potential failures (example failures - fan, backup power supply, switchgear).	DOE O 420.1B (Facility Safety, Chapter I, Sec. 3.b(8))
	The two OGE fans in each of the two OGE sub-systems are aligned as one operating, one in standby to provide redundancy. A fan failure is indicated in the control room as a low system static pressure alarm. The standby fan is started manually to restore system operability. A standby diesel generator automatically supplies backup power to the OGE fans and control equipment upon a loss of normal power. The system backup power feature is not credited in the DSA with a preventive or mitigative function following a design basis accident. The OGE fans are controlled from the facility control room. In the case of fan failure, the associated discharge damper closes automatically to preclude backflow as the standby fan is placed in service. Operation of the fans is not credited in the DSA. However, this evaluation to Safety Class criteria identifies a system deficiency, i.e. fan failure does not automatically start the standby fan. Operator action is required. All four OGE fans receive backup power from a single diesel generator, the reliability of the OGE system to prevent the over pressurization or explosion would be enhanced if the OGE fans were supplied backup power from two separate diesel generators. This would reduce the probability of occurrence of two of the five events to be evaluated from Table 4-3. <u>Gap Analysis</u> Gap Number 21: Discretionary Gap - Failure of online fan does not automatically start the Standby fan. Gap Number 22: Discretionary Gap - Fan MCCs are fed by the same D/G.	

Evaluation Criteria	Discussion	Reference
10.2 Automatic backup electrical power shall be provided to all critical instruments and equipment required to operate and monitor the confinement ventilation system.	[DOE Guidance Document does not provide any specific evaluation guidance discussion for this criteria]	DOE-HDBK-1169 (2.2.7)
	A standby diesel generator automatically supplies backup power to the OGE fans and control equipment upon a loss of normal power. The control room OGE system static pressure alarm and fan status indicators are provided with automatic back-up power. Three (3) local glovebox static pressure alarms and (1) local OGE system branch pressure alarm do not have the backup power feature. Local instrumentation (glovebox differential pressure indicators) does not depend on back-up power for operation. The system backup power feature is not credited in the DSA with a preventive or mitigative function following a design basis accident. <u>Gap Analysis</u> No Gap	
10.3 Backup electrical power shall be provided to all critical instruments and equipment required to operate and monitor the confinement ventilation system.	NOTE: Safety Class is addressed through previous line.	DOE-HDBK-1169 (2.2.7)
	This evaluation criteria is NOT APPLICABLE, as it is an SS-only criteria. SRNL confinement ventilation systems are evaluated to SC criteria.	

Evaluation Criteria	Discussion	Reference
11 - Other Credited Functional Requirements		
11.1 Address any specific functional requirements for the confinement ventilation system (beyond the scope of those above) credited in the DSA.	[DOE Guidance Document does not provide any specific evaluation guidance discussion for this criteria]	10 CFR 830, Subpart B
	None <u>Gap Analysis</u> No Gaps	

Evaluation Criteria	Discussion	Reference
0 - Ventilation System Description & References		
0.1 System Description	N/A <u>System Description</u> The Process Hood Exhaust (PHEX) systems are two independent systems serving Sections B&C. Each system serves various enclosures, rooms or cells in the respective section of the building. The Section B&C systems (Figure A) have single or double stage HEPA filtration, and normal and standby exhaust fans. Both systems discharge to the SRNL Fan Housing Sand Filter (FHSF) system. All the fans are provided with standby power. The building framing, roof slabs and floor slabs have been qualified to PC-3. The building shell walls (windows and transite panels) have been qualified to PC-1. Interior partitions, systems and components are qualified to a mixture of PC-1 and PC-2.	N/A

Evaluation Criteria	Discussion	Reference
0.2 System References	N/A	N/A

Standards
- o DuPont Specifications 3027, 3017, 8728.
- o DuPont standard H16J, Flexible connections
- o M-SPP-G-00243, HEPA Filter Specification
- o SRS Engineering Standard 15888, HEPA Filter Requirements
- o ANSI/ASME NQA-1, Quality Assurance Program Requirements for Nuclear Facilities, 1997
- o DOE-STD-3020-2005, DOE Technical Standard - Specification for HEPA Filters Used by DOE Contractors
- o DOE-STD-3025-2007, DOE Technical Standard - Quality Assurance Inspection and Testing of HEPA Filters
- o UL 586, UL Standard for Safety, High Efficiency, Particulate, Air Filter Units, 1996.

References

System Design Descriptions (SDDs):
- o G-SYD-A-00005, PHEX System Design Description
- o M-SYD-A-00024, IA, PLTA, and Compressor Alternate CW

Air Balance Test Procedures (TPs):
- o TP-02-773A-BWING-01, Sec B Air Balance Test Procedure
- o TP-03-773A-CWING-01, Sec C Air Balance Test Procedure
- o 5Q1.2 Procedure 484, Building Air Survey

Operator Round Sheets:
- o ROD-OPS-2002-002 - Control Area Operator (CAO) Round Sheets
- o ROD-OPS-2002-003 - Facility Operator (FO) Round Sheets

Miscellaneous
- o SRNL-ESD-2007-00017, Structural Integrity Program Scope, Resources & Estimate, 02/07/07
- o SRNL-ROE-2007-00063, Table 4.3 submittal
- o WSRC-SA-2, Revision 3, February 2007, SRNL Technical Area Documented Safety Analysis (DSA)
- o WSRC-TS-97-00014, SRNL Technical Area (TA) Technical Safety Requirements (TSRs)

P&IDs
- o M-M6-A-0191, CHEX Diversion Exhaust P&ID - Section B
- o M-M6-A-0192, CHEX Diversion Exhaust P&ID - Section C

Evaluation Criteria	Discussion	Reference
	1 - Ventilation System – General Criteria	
1.1 Pressure differential should be maintained between zones and atmosphere.	Number of zones as credited by accident analysis to control hazardous material release; demonstrate by use considering potential in-leakage.	DOE-HDBK-1169 (2.2.9) ASHRAE Design Guide
	The Sections B&C zone flows and ventilation system interactions are described in the specific SDD documents (see references in Section 0.2). Differential pressures (DPs) are not measured directly, but are maintained between zones by monitoring and balancing air flows. Periodic monitoring is conducted, including hood face velocities (Procedure 4Q/401) and air flow directions (Procedure 5Q1.2/484). Air balances are regularly conducted on all ventilation systems within a building section to verify facility design basis flows, as documented by the Sections B&C Air Balance test procedures (see references in Section 0.2). Key system parameters are recorded on a daily and weekly basis (operator rounds shown below) which allows monitoring of ventilation system function and performance. The PHEX Systems are designed to maintain the primary containment zones at a negative pressure with respect to surrounding areas such that a positive airflow is maintained into the primary confinement zones from the secondary confinement zones. Confinement Zones o Primary Confinement — Lab Hoods / Gloveboxes / Ducting through 1st testable HEPA filter stage o Secondary Confinement — Labs / Filter Rooms / Equipment Rooms / Service Corridor o Tertiary Confinement — Personnel Corridors / Offices / General Service Floor Area o Administrative Area — Sections A&D / Offices Gap Analysis No Gap - Pressure differentials are not measured directly, but are maintained between zones by monitoring and balancing air flows.	
1.2 Materials of construction should be appropriate for normal, abnormal and accident conditions.	[DOE Guidance Document does not provide any specific evaluation guidance discussion for this criteria]	DOE-HDBK-1169 (2.2.5) ASME AG-1
	Sections B&C PHEX Systems exhaust air from labs with enclosures with a higher potential to release radionuclides and that require higher levels of filtration. PHEX ducting extends from lab modules to the primary filter plenum. 1/8" thick stainless steel blanks with 1/8" thick neoprene gaskets are used to separate portions of the primary and secondary filter plenums for CHEX or PHEX service. PHEX fans in Section B are fabricated from stainless steel. PHEX fans in Section C are fabricated from epoxy coated steel. 16 gauge stainless steel ducting carries the filtered exhaust to PHEX fans on the roof. The PHEX fans discharge to the Sand Filter inlet ducting (stainless steel). Gap Analysis No Gap - All materials of construction are appropriate for normal, abnormal and accident conditions. Inspections conducted as part of the Structural Integrity Program on the inside of the Section B&C HEPA ductwork to date have shown no reasons why the ventilation system cannot perform it's intended function during all conditions.	

Evaluation Criteria	Discussion	Reference
1.3 Exhaust system should withstand anticipated normal, abnormal and accident system conditions and maintain confinement integrity.	As required by accident analysis to prevent accident release. The 773-A Building ventilation system consists of intake and exhaust ducting, dampers, fans, filters banks, associated controls and instrumentation. The 773-A Building ventilation system minimizes the potential release of radioactive contamination in the event of a process leak. The ventilation system is designed to maintain the building at a slight negative pressure with respect to its surrounding. The PHEX systems, along with the CHEX and OGE systems, are designed to maintain the primary containment zones at a negative pressure with respect to surrounding areas such that a positive airflow is maintained into the primary confinement zones from the secondary confinement zones. During normal operation these multiple systems run continuously within defined performance parameters to maintain the proper containment air flow. All exhaust air flows except HV systems are filtered through HEPA filters. The PHEX, OGE, and CHEX (Diversion Exhaust) systems exhaust to the Sand Filter (FHSF) system. The 773-A PHEX ventilation fans are located on the roof and are exposed to the weather. Ventilation ductwork from Bldg. 773-A to the FHSF Sand Filter is exposed to the weather. All other fans and ventilation components are located indoors. The ventilation system components are adequate for normal and most abnormal operation. Abnormal conditions include power failure, partial shutdown, or activation of the CHEX (Diversion Exhaust) system. In the event of a power failure, conditioned air will be supplied to clean areas only. All supply systems receiving outside air have freeze stats to automatically shut the fans down to prevent component damage due to freezing temperatures. Office and laboratory supply fans share a common outside inlet and windbox. Supply air (HVAC) fans that supply laboratory spaces have automatic dampers on the fan discharge that close if the fan is de-energized to prevent the possibility of the backflow of air from the laboratories to the inlet of the office supply fans. Partial shutdown of ventilation systems is addressed by operating procedures TO-06-011, Reduction/Restoration of C Section CHEX and TO-06-015, Reduction/Restoration of B Section CHEX. Activation of the CHEX Diversion system shuts down approximately 2/3rds of the Sections B&C supply air (HVAC) fans to insure that the facility air balance is maintained. The following accident scenarios are considered. Process Explosion - Unstable Lab Chemical or Accumulation of Process Flammable Gas or VOCs with no consequential fire - Ventilation systems would operate normally to maintain a positive pressure differential into the effected lab. Exhaust flows through HEPA filtration are believed adequate to contain mobilized contaminants. If the HEPA plugs, the contaminants would be contained within the lab and ductwork. If the HEPA is compromised and contamination is detected in the B or C stack, the CHEX Diversion system would be placed in service to direct exhaust air to the Sand Filter. If a filter housing or ducting is compromised, the RREX (Exhaust) systems would contain the contamination. Fire detection systems would alert Control Room Operators who would shut down ventilation systems according to procedures. Lab/Cell walls, Gloveboxes, and ductwork would passively contain contaminants. Explosion - Glovebox Overpressurization - same as above. Explosion - Accumulation of Distributed Flammable Gas with no consequential fire - same as above. Drop / Spill - Ventilation systems would operate normally to draw lab/cell air towards hoods. Normal room infiltration would	DOE-HDBK-1169 (2.4) ASHRAE Design Guide

Evaluation Criteria	Discussion	Reference
	contain the spill to the effected lab/cell. Exhaust flows through HEPA filtration are believed adequate to contain mobilized contaminants. If the HEPA plugs, the contaminants would be contained within the lab and ductwork. If the HEPA is compromised and contamination is detected in the B or C stack, the Diversion system would be placed in service to direct exhaust air to the Sand Filter. If filter housings or ducting are compromised, the RREX systems would contain the contamination. <u>Gap Analysis</u> No Gaps.	
1.4 Confinement ventilation systems shall have appropriate filtration to minimize release.	Address: 1) Type of filter (e.g., HEPA, sand, sintered metal); 2) Filter sizing (flow capacity and pressure drop); 3) Decontamination Factor vs. accident analysis assumptions. Separate Sections B&C PHEX systems utilize parallel banks of one pre-filter and either one or two HEPA filters in series. Only the "slide in/tape in place" configuration is used. HEPA Filters used are listed below. A review of air balance data indicates that all HEPA filters are properly sized. Prior to receipt the filters are tested at the Independent Filter Testing Facility (FTF) to confirm an efficiency of at least 99.97% for a decontamination factor DF = 3333. Decontamination factor has not been considered in the facility DSA. The filters are credited with confinement function only, not dose reduction. HEPA filters "slide in/tape in place" - 24x30x11-1/2, 1250 cfm @ 1.0 in wc, plywood frame, back neoprene gasket , Stores code 32.1850.04, Flanders Filters Drawing Z95295, Rev. B Prefilters - "slide in/tape in place" - 20x25x2 (stores code 50.16130), Am Filter 301 or Farr Co 30/30 Class 1 <u>Gap Analysis</u> No gaps.	ASME AG-1 DOE-HDBK-1169 (2.2.1)

Evaluation Criteria	Discussion	Reference
2 - Ventilation System – Instrumentation & Control		
2.1 Provide system status instrumentation and/or alarms.	Address key information to ensure system operability (e.g., system delta-P, filter pressure drop). The Sections B&C PHEX systems (two fans per section) are instrumented on the cabinet status boards (#2 for B, #5 for C) in the C041 CR to show fan status and permit fan starting and stopping. The fan low suction pressure alarms are routed to the C041 CR through the PSV control system. See CHEX system for HEPA DP indications. <u>Gap Analysis</u> No Gaps	ASME AG-1 DOE-HDBK-1169 ASHRAE Design Guide (Section 4)
2.2 Interlock supply and exhaust fans to prevent positive pressure differential.	[DOE Guidance Document does not provide any specific evaluation guidance discussion for this criteria] The Section B&C PHEX exhaust fans (two per section) are not interlocked with their HVAC supply fan counterparts to prevent positive DPs. <u>Gap Analysis</u> Gap Number 3: Discretionary Gap - Interlocks are not provided between the supply and exhaust systems.	DOE-HDBK-1169 ASHRAE Design Guide (Section 4)
2.3 Post accident indication of filter break-through.	Instrumentation supports post accident planning and response; should be considered critical instrumentation for SC. Section B&C PHEX exhaust systems both have low HEPA filter DP indicators, indicating break-through, and stack activity monitoring. The Sand Filter Stack is equipped with an isokinetic sampling system to continuously monitor exhaust air flow and activity. <u>Gap Analysis</u> No Gap - Post accident monitoring capabilities are installed as indicated above.	TECH-34

Evaluation Criteria	Discussion	Reference
2.4 Reliability of control system to maintain confinement function under normal, abnormal and accident conditions.	Address, for example, impacts of potential common mode failures from events that would require active confinement function. Sections B&C each contain two parallel PHEX fans controlled from the C041 CR. Normally one fan operates continuously and one fan is in standby. If the exhaust plenum pressure drops to 1.5 in wc the primary fan is de-energized and the standby fan is energized. Abnormal conditions include power failure and partial shutdown. Activation of the CHEX (Diversion) system does not affect the PHEX systems. In the event of a power failure, standby power is supplied to all PHEX fans. The standby fan in each section will restart automatically. Under the four accident scenarios, the PHEX systems would function normally. The Sections B&C PHEX exhaust systems each have redundant fans that are powered with standby power. Operation of the systems is controlled by operating procedures. System control is maintained during abnormal and accident conditions by AOPs and EOPs. <u>Gap Analysis</u> No Gap -The Sections B&C PHEX fans can be controlled from the C041 CR under all conditions.	DOE-HDBK-1169 (2.4)
2.5 Control components should fail safe.	[DOE Guidance Document does not provide any specific evaluation guidance discussion for this criteria] The Sections B&C PHEX exhaust system fans have discharge dampers that fail closed on loss of instrument air and power. <u>Gap Analysis</u> No Gap - The PHEX fan damper failure mode is appropriate to prevent backflow from the Sand Filter.	DOE-HDBK-1169 (2.4)

Evaluation Criteria	Discussion	Reference
3 - Resistance to Internal Events – Fire		
3.1 Confinement ventilation systems should withstand credible fire events and be available to operate and maintain confinement.	Required for new facilities; as required by the accident analysis for existing facilities (discretionary). Must address protection of filter media.	DOE-HDBK-1169 (10.1) DOE-STD-1066
	As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Page 21 and 22 Discussion, the evaluation of internal fire events for an existing facility is only required if the accident analysis takes credit for the active confinement ventilation system.	
3.2 Confinement ventilation systems should not propagate spread of fire.	Required for new facilities; as required by the accident analysis for existing facilities (discretionary). Address fire barriers, fire dampers arrangement.	DOE-HDBK-1169 (10.1) DOE-STD-1066
	As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Page 21 and 22 Discussion, the evaluation of internal fire events for an existing facility is only required if the accident analysis takes credit for the active confinement ventilation system.	

Evaluation Criteria	Discussion	Reference
4 - Resistance to External Events – Natural Phenomena – Seismic		
4.1 Confinement ventilation systems should safely withstand earthquakes.	If the active CVS system is not credited in a seismic accident condition there is no need to evaluate that performance and/or design attribute for the confinement ventilation system (discretionary). Also, any seismic impact on the confinement ventilation system performance will be based on the current functional requirements in the DSA. NOTE: Seismic requirements may apply to Defense-in-Depth items indirectly for the protection of safety SSCs.	ASME AG-1 (AA) DOE O 420.1B DOE-HDBK-1169 (9.2)
	As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per 2004-2 Ventilation System Evaluation Guidance Addendum, March 6, 2007, Caution 4 and Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Page 22 Discussion, the evaluation of seismic events is only required if the accident analysis takes credit for the active confinement ventilation system during or after the NPH event.	

Evaluation Criteria	Discussion	Reference
5 - Resistance to External Events – Natural Phenomena – Tornado/Wind		
5.1 Confinement ventilation systems should safely withstand tornado depressurization.	If the active CVS is not credited in a tornado condition there is no need to evaluate that performance and/or design attribute for the confinement ventilation system (discretionary). Also, any tornado impact on the confinement ventilation system performance will be based on the current functional requirements in the DSA. As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per 2004-2 Ventilation System Evaluation Guidance Addendum, March 6, 2007, Caution 4 and Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Pages 22 and 23 Discussion, the evaluation of tornado and wind events is only required if the accident analysis takes credit for the active confinement ventilation system during or after the NPH event.	DOE O 420.1B DOE-HDBK-1169 (9.2)
5.2 Confinement ventilation systems should withstand design wind effects on system performance.	If the active CVS is not credited in a wind condition there is no need to evaluate that performance and/or design attribute for the confinement ventilation system (discretionary). Also, any wind impact on the confinement ventilation system performance will be based on the current NP analysis in the DSA. As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per 2004-2 Ventilation System Evaluation Guidance Addendum, March 6, 2007, Caution 4 and Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Pages 22 and 23 Discussion, the evaluation of tornado and wind events is only required if the accident analysis takes credit for the active confinement ventilation system during or after the NPH event.	DOE O 420.1B DOE-HDBK-1169 (9.2)

	Evaluation Criteria	Discussion	Reference
		6 - Other NP Events (eg. flooding, precipitation)	
6.1	Confinement ventilation system should withstand other NP events considered credible in the DSA where the confinement ventilation system is credited.	If the active confinement ventilation system is not credited for this event there is no need to evaluate that performance and/or design attribute for the confinement ventilation system (discretionary). Also, any impact on the confinement ventilation system performance will be based on the current NP analysis in the DSA.	DOE O 420.1B DOE-HDBK-1169 (9.2)
		As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per 2004-2 Ventilation System Evaluation Guidance Addendum, March 6, 2007, Caution 4 and Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Page 23 Discussion, the evaluation of other NPH events is only required if the accident analysis takes credit for the active confinement ventilation system during or after the NPH event.	

Evaluation Criteria	Discussion	Reference
7 - Range Fires / Dust Storms		
7.1 Administrative controls should be established to protect confinement ventilation systems from barrier threatening events.	Ensure appropriately thought out response to external threat is defined (e.g. pre-fire plan). The Savannah River Forestry Department is responsible for fire fighting efforts in regards to wildland fires. They also have a program of controlled burns and mechanical thinning of underbrush to limit or prevent wildland fire spreading out of control. If the fire encroaches upon SRNL, the Savannah River Site Fire Department will direct extinguishing efforts. Building 773-A has a current Fire Pre Plan and has procedures to reduce confinement ventilation system air flow (originally developed for electrical system Maintenance) that will minimize soot loading of the filters in the ventilation systems. Reference: AOP-06-007 Gap Analysis No Gap - Administrative controls are sufficient to protect the confinement ventilation systems for barrier threatening events.	DOE O 420.1B

Evaluation Criteria	Discussion	Reference
8 - Testability		
8.1 Design supports the periodic inspection and testing of filters and housing, and test and inspections are conducted periodically.	Ability to test for leakage per intent of N510.	DOE-HDBK-1169 (2.3.8) ASME AG-1 ASME N510
	Surveillance Requirements for the PHEX HEPA filters are specified in the SRNL TSR, WSRC-TS-97-00014, PHEX SR 4.2.3.1. All HEPA filter housings have the capability for in-place testing. This in-place test capability was added in the 1960's and testing points meet the intent of N510. The design of the tape-in-place housings discussed under Criteria 1.4 provides unique challenges in testing filter housing pressure boundary integrity. When the filter banks for multiple labs are manifolded together, the configuration does not ensure uniformity of aerosol challenge. Inspection of the housings is part of the Structural Integrity Program. The system is assessed for material buildup following a process event. B&C PHEX HEPA filters are tested every 18 months to verify that they have an efficiency of greater or equal to 99.5%. <u>Gap Analysis</u> Gap Number 4: Discretionary Gap - Tape-in-place HEPA filters do not meet the filter housing pressure boundary integrity testing requirements in N510.	
8.2 Instrumentation required to support system operability is calibrated.	Credited instrumentation should have specified calibration / surveillance requirements. Non-safety instrumentation should be calibrated as necessary to support system functionality.	DOE-HDBK-1169 (2.3.8)
	Separate Sections B&C PHEX systems have no calibration requirements in the TSR. Non-safety instrumentation is calibrated on an as-needed basis. <u>Gap Analysis</u> No Gap - The Sections B&C PHEX systems have no TSR calibration requirements.	
8.3 Integrated system performance testing is specified and performed.	Required responses assumed in the accident analysis must be periodically confirmed including any time constraints.	DOE-HDBK-1169 (2.3.8)
	Airflow direction is verified at key points within the building during scheduled inspections to verify that the ventilation systems are functioning as intended. Findings are forwarded to the Design Authority Engineer. No functional testing is required by the TSR of the B&C PHEX systems. <u>Gap Analysis</u> No Gap - The Sections B&C PHEX systems have no integrated system performance testing that is required.	

Evaluation Criteria	Discussion	Reference
9 - Maintenance		
9.1 Filter service life program should be established.	Filter life (shelf life, service life, total life) expectancy should be determined. Consider: filter environment, maximum delta-P, radiological loading, age, and potential chemical exposure. The Sections B&C PHEX HEPA filters are controlled by TO-06-014, Control of TSR HEPA AET and Engineering Standard 15888 (HEPA Filter Requirements) which is the basis of DOE-HDBK-1169 Appendix C. Maximum HEPA shelf life is three (3) years and maximum HEPA total life is ten (10) years. <u>Gap Analysis</u> No Gaps - The Sections B&C PHEX HEPA filter maximum service life of 10 years has been established and controlled by the SRNL HEPA Filter Database and Computerized Maintenance Management System. Nominal PHEX HEPA filter changeout plans are begun at seven (7) years (Computerized Maintenance Management System) to ensure compliance with the ten (10) year requirement.	DOE-HDBK-1169 (3.1 & App C)

Evaluation Criteria	Discussion	Reference
10 - Single Failure		
10.1 Failure of one component (equipment or control) shall not affect continuous operation.	Address potential failures (example failures - fan, backup power supply, switchgear). PHEX systems has redundent fans with separate control loops. Fans are provided power from separate motor control centers fed from segragated swtichgear but standby power is provided by the same Diesel Generator (794-A D/G). Gap Analysis Gap Number 15: Discretionary Gap - Fan MCCs are fed by the same D/G.	DOE O 420.1B (Facility Safety, Chapter I, Sec. 3.b(8))
10.2 Automatic backup electrical power shall be provided to all critical instruments and equipment required to operate and monitor the confinement ventilation system.	[DOE Guidance Document does not provide any specific evaluation guidance discussion for this criteria] In the event of a power failure, standby power will be provided to all Sections B&C PHEX fans. The PHEX fans that were running will restart automatically. The standby fans will be available for automatic standby service. Gap Analysis No Gap - Standby power is provided to both PHEX fans in each section.	DOE-HDBK-1169 (2.2.7)
10.3 Backup electrical power shall be provided to all critical instruments and equipment required to operate and monitor the confinement ventilation system.	NOTE: Safety Class is addressed through previous line. This evaluation criteria is NOT APPLICABLE, as it is an SS-only criteria. SRNL confinement ventilation systems are evaluated to SC criteria.	DOE-HDBK-1169 (2.2.7)

Evaluation Criteria	Discussion	Reference
11 - Other Credited Functional Requirements		
11.1 Address any specific functional requirements for the confinement ventilation system (beyond the scope of those above) credited in the DSA.	[DOE Guidance Document does not provide any specific evaluation guidance discussion for this criteria]	10 CFR 830, Subpart B
	None <u>Gap Analysis</u> No Gap	

Evaluation Criteria	Discussion	Reference
0 - Ventilation System Description & References		
0.1 System Description	N/A	N/A
	System Description The Sections B&C Shielded Area Regulated Room Exhaust (RREX) systems are two independent systems with single stage HEPA filtration and single exhaust fans that discharge to the 75 ft stack located at each section of the building. The fans are not provided with standby power. The Sections B&C Equipment Room Regulated Room Exhaust (RREX) systems are two independent systems with single stage HEPA filtration and single exhaust fans that discharge to the 75 ft stack located at each section of the building. The fans are not provided with standby power. The stack, building framing, roof slabs and floor slabs have been qualified to PC-3. The building shell walls (windows and transite panels) have been qualified to PC-1. Interior partitions, systems and components are qualified to a mixture of PC-1 and PC-2.	

Evaluation Criteria	Discussion	Reference
0.2 System References	N/A Standards o DuPont Specifications 3027, 3017, 8728. o DuPont standard H16J, Flexible connections o M-SPP-G-00243, HEPA Filter Specification o SRS Engineering Standard 15888, HEPA Filter Requirements o ANSI/ASME NQA-1, Quality Assurance Program Requirements for Nuclear Facilities, 1997 o DOE-STD-3020-2005, DOE Technical Standard - Specification for HEPA Filters Used by DOE Contractors o DOE-STD-3025-2007, DOE Technical Standard - Quality Assurance Inspection and Testing of HEPA Filters o UL 586, UL Standard for Safety, High Efficiency, Particulate, Air Filter Units, 1996. References Air Balance Test Procedures (TPs): o TP-02-773A-BWING-01, Sec B Air Balance Test Procedure o TP-03-773A-CWING-01, Sec C Air Balance Test Procedure o 5Q1.2 Procedure 484, Building Air Survey Operator Round Sheets: o ROD-OPS-2002-002 - Control Area Operator (CAO) Round Sheets o ROD-OPS-2002-003 - Facility Operator (FO) Round Sheets Miscellaneous o TO-06-005, Laboratory Services Department Non-TSR HEPA Filter Program o SRNL-ROE-2007-00063, Table 4.3 submittal o WSRC-SA-2, Revision 3, February 2007, SRNL Technical Area Documented Safety Analysis (DSA) P&IDs o M-M6-A-0183, CHEX Normal Exhaust P&ID - Section B o M-M6-A-0170, CHEX Normal Exhaust P&ID - Section C o M-M6-A-0159, B and C RREX P&ID o ST5-20318, C-001 Filter Housing Plan o ST5-20319, B-001 Filter Housing Plan o W156597, Equipment Room Plan - Section B o W156520, Equipment Room Plan - Section C	N/A

Evaluation Criteria	Discussion	Reference
1 - Ventilation System – General Criteria		
1.1 Pressure differential should be maintained between zones and atmosphere.	Number of zones as credited by accident analysis to control hazardous material release; demonstrate by use considering potential in-leakage.	DOE-HDBK-1169 (2.2.9) ASHRAE Design Guide
	RREX (Equipment Room Exhaust) systems exhaust air from B/C001 to maintain pressure differentials between the equipment rooms and atmosphere. RREX (Shielded Area Exhaust) systems exhaust air from B/C005 to maintain pressure differentials between the shielded areas or HEPA filter rooms and atmosphere (service level). <u>Gap Analysis</u> No Gap - Both RREX Systems (Equipment Room & Shielded Area) maintain needed DPs with atmosphere.	
1.2 Materials of construction should be appropriate for normal, abnormal and accident conditions.	[DOE Guidance Document does not provide any specific evaluation guidance discussion for this criteria]	DOE-HDBK-1169 (2.2.5) ASME AG-1
	RREX (Equipment Room Exhaust) systems exhaust air from the B/C001 Equipment Rooms through HEPA filters to a fan in each of the equipment rooms. The fans are fabricated from carbon steel. The fans discharge to the building stacks. Ducting is 16 gauge galvanized steel. HEPA Filters are located in the Equipment Rooms. Filter frames are stainless steel. RREX (Shielded Area Exhaust) systems exhaust air from the B/C005 Shielded Area filter rooms through galvanized steel ducting to an exhaust fan in each of the equipment rooms. The fans are fabricated from carbon steel and discharge by stainless steel ducting to the Sand Filter supply duct on the roof. HEPA Filters are located in the B/C005 Shielded Area filter rooms. HEPA filter housings and inlet and discharge duct sections are manufactured from 304L stainless steel. <u>Gap Analysis</u> No Gap - RREX (Equipment Room & Shielded Area) materials of construction are appropriate for all conditions.	

Evaluation Criteria	Discussion	Reference
1.3 Exhaust system should withstand anticipated normal, abnormal and accident system conditions and maintain confinement integrity.	As required by accident analysis to prevent accident release.	DOE-HDBK-1169 (2.4) ASHRAE Design Guide
	During normal operation the Equipment Room and Shielded Area RREX systems run continuously within defined performance parameters to maintain the proper containment air flow. Exhaust air flows are filtered through HEPA filters. Abnormal conditions include power failure, partial shutdown, or activation of the CHEX (Diversion Exhaust) system. The RREX systems will not operate in the event of a power failure. There is one Shielded Area RREX fan and one Equipment Room RREX fan in each section with no standby. Partial shutdown of ventilation systems is addressed by operating procedures TO-06-011, Reduction/Restoration of Section C CHEX and TO-06-015, Reduction/Restoration of Section B CHEX. Activation of the CHEX Diversion system does not effect the RREX Systems. The following accident scenarios are considered. Process Explosion - Unstable Lab Chemical or Accumulation of Process Flammable Gas or VOCs with no consequential fire - If a PHEX or CHEX filter housing or ducting is compromised, the RREX (Exhaust) systems would contain the contamination. Fire detection systems would alert Control Room Operators who would shut down ventilation systems according to procedures. Explosion - Glovebox Overpressurization - same as above. Explosion - Accumulation of Distributed Flammable Gas with no consequential fire - same as above. Drop / Spill - If a PHEX or CHEX filter housing or ducting is compromised, the RREX systems would contain the contamination. <u>Gap Analysis</u> No Gap - Both RREX systems (Equipment Room & Shielded Area) should withstand abnormal and accident conditions.	

Evaluation Criteria	Discussion	Reference
1.4 Confinement ventilation systems shall have appropriate filtration to minimize release.	Address: 1) Type of filter (e.g., HEPA, sand, sintered metal); 2) Filter sizing (flow capacity and pressure drop); 3) Decontamination Factor vs. accident analysis assumptions.	ASME AG-1 DOE-HDBK-1169 (2.2.1)
	RREX (Equipment Room Exhaust) Systems Separate Sections B&C systems utilize Flanders fluid seal, side loading (C-4) frames configured for four single stage HEPA filters in a two high X two wide arrangement. Original Design Airflow is 6000 cfm and current operating airflow is approx 4000 cfm. The filter bank capacity is 6000 cfm (Four 1500 cfm @ 1.3 in wc filters). RREX (Shielded Area Exhaust) Systems Separate Sections B&C systems utilize two parallel banks of HEPA filters. Each bank includes a "bag-in/bag-out" pre-filter section and a "bag-in/bag-out" HEPA filter section in series. Each section consists of six filters in a two-high X three-wide arrangement (two parallel flow paths). System airflow is 10,000 cfm which is within the capacity of three of the four filter flow paths on-line (Nine 1500 cfm @ 1.3 in wc filters). Both RREX Systems Prior to receipt the filters are tested at the Independent Filter Testing Facility (FTF) to confirm an efficiency of at least 99.97% for a decontamination factor DF = 3333. Decontamination factor has not been considered in the facility DSA. <u>Gap Analysis</u> No Gaps	

Evaluation Criteria	Discussion	Reference
2 - Ventilation System – Instrumentation & Control		
2.1 Provide system status instrumentation and/or alarms.	Address key information to ensure system operability (e.g., system delta-P, filter pressure drop).	ASME AG-1 DOE-HDBK-1169 ASHRAE Design Guide (Section 4)
	RREX (Equipment Room Exhaust and Shielded Area Exhaust) Systems The Sections B&C RREX systems (one fan per section) are instrumented on the cabinet status boards (#2 for B, #5 for C) in the C041 CR to show fan status and permit fan starting and stopping. HEPA Filters are provided with DP gauges. Gap Analysis No Gaps	
2.2 Interlock supply and exhaust fans to prevent positive pressure differential.	[DOE Guidance Document does not provide any specific evaluation guidance discussion for this criteria]	DOE-HDBK-1169 ASHRAE Design Guide (Section 4)
	RREX (Equipment Room Exhaust and Shielded Area Exhaust) Systems The Sections B&C Equipment Room RREX fans (one per section) are not interlocked with their equipment room HVAC supply fan counterparts to prevent positive DPs. The Sections B&C Shielded Areas have no direct supply fans to cause overpressurization. Gap Analysis Gap Number 16: Discretionary Gap - Interlocks are not provided between supply and exhaust systems.	
2.3 Post accident indication of filter break-through.	Instrumentation supports post accident planning and response; should be considered critical instrumentation for SC.	TECH-34
	RREX (Equipment Room & Shielded Area Exhaust) Systems The Sections B&C RREX (Equipment Room & Shielded Area) exhaust systems discharge to the section B&C stacks. Separate Sections B&C Stack Monitoring systems are in place to detect radioactivity above preset conditions. Gap Analysis No Gap - The Sections B&C RREX (Equipment Room & Shielded Area) exhaust fans, located in B/C001. appropriately exhaust to monitored stacks.	

Evaluation Criteria	Discussion	Reference
2.4 Reliability of control system to maintain confinement function under normal, abnormal and accident conditions.	Address, for example, impacts of potential common mode failures from events that would require active confinement function. RREX (Equipment Room & Shielded Area Exhaust) Systems each contain one fan. They are controlled from the Control Room and operate continuously. Activation of the Diversion system does not affect the RREX systems. In the event of a power failure, standby power is not provided to any of the RREX fans. The RREX fans (Equipment Room & Shielded Area) in each section will restart automatically. Under the four accident scenarios, the RREX systems would function normally. The C RREX (Equipment Room) exhaust fans are not interlocked with their B/C001 equipment room supply (HVAC) fans. Gap Analysis No Gaps	DOE-HDBK-1169 (2.4)
2.5 Control components should fail safe.	[DOE Guidance Document does not provide any specific evaluation guidance discussion for this criteria] RREX (Equipment Room & Shielded Area Exhaust) System fans each have discharge dampers that fail closed on loss of power. Gap Analysis No Gap - RREX (Equipment Room & Shielded Area) exhaust system control components fail in a safe condition.	DOE-HDBK-1169 (2.4)

Evaluation Criteria	Discussion	Reference
3 - Resistance to Internal Events – Fire		
3.1 Confinement ventilation systems should withstand credible fire events and be available to operate and maintain confinement.	Required for new facilities; as required by the accident analysis for existing facilities (discretionary). Must address protection of filter media.	DOE-HDBK-1169 (10.1) DOE-STD-1066
	As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Page 21 and 22 Discussion, the evaluation of internal fire events for an existing facility is only required if the accident analysis takes credit for the active confinement ventilation system.	
3.2 Confinement ventilation systems should not propagate spread of fire.	Required for new facilities; as required by the accident analysis for existing facilities (discretionary). Address fire barriers, fire dampers arrangement.	DOE-HDBK-1169 (10.1) DOE-STD-1066
	As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Page 21 and 22 Discussion, the evaluation of internal fire events for an existing facility is only required if the accident analysis takes credit for the active confinement ventilation system.	

Evaluation Criteria	Discussion	Reference
4 - Resistance to External Events – Natural Phenomena – Seismic		
4.1 Confinement ventilation systems should safely withstand earthquakes.	If the active CVS system is not credited in a seismic accident condition there is no need to evaluate that performance and/or design attribute for the confinement ventilation system (discretionary). Also, any seismic impact on the confinement ventilation system performance will be based on the current functional requirements in the DSA. NOTE: Seismic requirements may apply to Defense-in-Depth items indirectly for the protection of safety SSCs.	ASME AG-1 (AA) DOE O 420.1B DOE-HDBK-1169 (9.2)
	As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per 2004-2 Ventilation System Evaluation Guidance Addendum, March 6, 2007, Caution 4 and Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Page 22 Discussion, the evaluation of seismic events is only required if the accident analysis takes credit for the active confinement ventilation system during or after the NPH event.	

Evaluation Criteria	Discussion	Reference
5 - Resistance to External Events – Natural Phenomena – Tornado/Wind		
5.1 Confinement ventilation systems should safely withstand tornado depressurization.	If the active CVS is not credited in a tornado condition there is no need to evaluate that performance and/or design attribute for the confinement ventilation system (discretionary). Also, any tornado impact on the confinement ventilation system performance will be based on the current functional requirements in the DSA. As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per 2004-2 Ventilation System Evaluation Guidance Addendum, March 6, 2007, Caution 4 and Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Pages 22 and 23 Discussion, the evaluation of tornado and wind events is only required if the accident analysis takes credit for the active confinement ventilation system during or after the NPH event.	DOE O 420.1B DOE-HDBK-1169 (9.2)
5.2 Confinement ventilation systems should withstand design wind effects on system performance.	If the active CVS is not credited in a wind condition there is no need to evaluate that performance and/or design attribute for the confinement ventilation system (discretionary). Also, any wind impact on the confinement ventilation system performance will be based on the current NP analysis in the DSA. As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per 2004-2 Ventilation System Evaluation Guidance Addendum, March 6, 2007, Caution 4 and Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Pages 22 and 23 Discussion, the evaluation of tornado and wind events is only required if the accident analysis takes credit for the active confinement ventilation system during or after the NPH event.	DOE O 420.1B DOE-HDBK-1169 (9.2)

	Evaluation Criteria	Discussion	Reference
		6 - Other NP Events (eg. flooding, precipitation)	
6.1	Confinement ventilation system should withstand other NP events considered credible in the DSA where the confinement ventilation system is credited.	If the active confinement ventilation system is not credited for this event there is no need to evaluate that performance and/or design attribute for the confinement ventilation system (discretionary). Also, any impact on the confinement ventilation system performance will be based on the current NP analysis in the DSA.	DOE O 420.1B DOE-HDBK-1169 (9.2)
		As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per 2004-2 Ventilation System Evaluation Guidance Addendum, March 6, 2007, Caution 4 and Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Page 23 Discussion, the evaluation of other NPH events is only required if the accident analysis takes credit for the active confinement ventilation system during or after the NPH event.	

Evaluation Criteria	Discussion	Reference
7 - Range Fires / Dust Storms		
7.1 Administrative controls should be established to protect confinement ventilation systems from barrier threatening events.	Ensure appropriately thought out response to external threat is defined (e.g. pre-fire plan).	DOE O 420.1B
	The Savannah River Forestry Department is responsible for fire fighting efforts in regards to wildland fires. They also have a program of controlled burns and mechanical thinning of underbrush to limit or prevent wildland fire spreading out of control. If the fire encroaches upon SRNL, the Savannah River Site Fire Department will direct extinguishing efforts. Building 773-A has a current Fire Pre Plan and has procedures to reduce confinement ventilation system air flow (originally developed for electrical system Maintenance) that will minimize soot loading of the filters in the ventilation systems. Reference: AOP-06-007 Gap Analysis No Gap - Administrative controls are sufficient to protect the confinement ventilation systems for barrier threatening events.	

Evaluation Criteria	Discussion	Reference
8 - Testability		
8.1 Design supports the periodic inspection and testing of filters and housing, and test and inspections are conducted periodically.	Ability to test for leakage per intent of N510. RREX (Equipment Room & Shielded Area Exhaust) Systems have no surveillance requirements. The filter housings are designed to allow in-place efficiency testing. The HEPA Filter Testing Program requires HEPA filters in active radiological service to be changed periodically and tested periodically. They will also be assessed for material buildup following a process event (triggered by SIRIM criteria). The RREX HEPA filters are all tested on an annual frequency to verify that they have an efficiency of greater or equal to 99.5%. <u>Gap Analysis</u> No Gap - Design supports periodic filter testing and inspection, and inspections are conducted periodically.	DOE-HDBK-1169 (2.3.8) ASME AG-1 ASME N510
8.2 Instrumentation required to support system operability is calibrated.	Credited instrumentation should have specified calibration / surveillance requirements. Non-safety instrumentation should be calibrated as necessary to support system functionality. RREX (Equipment Room & Shielded Area Exhaust) Systems have no calibration requirements in the TSR. Non-safety instrumentation is calibrated on an as-needed basis. <u>Gap Analysis</u> No Gap - The RREX Systems have no calibration requirements in the TSR.	DOE-HDBK-1169 (2.3.8)
8.3 Integrated system performance testing is specified and performed.	Required responses assumed in the accident analysis must be periodically confirmed including any time constraints. RREX (Equipment Room & Shielded Area Exhaust) Systems have no requirements in the TSR for integrated system performance testing. <u>Gap Analysis</u> No Gap - The RREX Systems have no testing requirements in the TSR.	DOE-HDBK-1169 (2.3.8)

Evaluation Criteria	Discussion	Reference
9 - Maintenance		
9.1 Filter service life program should be established.	Filter life (shelf life, service life, total life) expectancy should be determined. Consider: filter environment, maximum delta-P, radiological loading, age, and potential chemical exposure. RREX (Equipment Room & Shielded Area Exhaust) System HEPA filters are controlled by the Non-TSR HEPA Filter Program (TO-06-005) and Engineering Standard 15888 (HEPA Filter Requirements) which is the basis of DOE-HDBK-1169 Appendix C. This program sets a 3 year maximum shelf life and a 10 year maximum total life. <u>Gap Analysis</u> No Gap - The RREX HEPA filter service life program is established.	DOE-HDBK-1169 (3.1 & App C)

Evaluation Criteria	Discussion	Reference
10 - Single Failure		
10.1 Failure of one component (equipment or control) shall not affect continuous operation.	Address potential failures (example failures - fan, backup power supply, switchgear).	DOE O 420.1B (Facility Safety, Chapter I, Sec. 3.b(8))
	Failure of any RREX (Equipment Room & Shielded Area Exhaust) system fan will interrupt continuous operation because none of the fans have a standby spare. Gap Analysis Gap Number 17: Discretionary Gap - Four exhaust sub-systems are not provided with a standby fan.	
10.2 Automatic backup electrical power shall be provided to all critical instruments and equipment required to operate and monitor the confinement ventilation system.	[DOE Guidance Document does not provide any specific evaluation guidance discussion for this criteria]	DOE-HDBK-1169 (2.2.7)
	RREX (Equipment Room & Shielded Area Exhaust) Systems will not operate in the event of a power failure. There is one Equipment Room (RREX) fan and one Shielded Area (RREX) fan in each section with no standby. Gap Analysis Gap Number 18: Discretionary Gap - Fans not provided with automatic backup electrical power.	
10.3 Backup electrical power shall be provided to all critical instruments and equipment required to operate and monitor the confinement ventilation system.	NOTE: Safety Class is addressed through previous line.	DOE-HDBK-1169 (2.2.7)
	This evaluation criteria is NOT APPLICABLE, as it is an SS-only criteria. SRNL confinement ventilation systems are evaluated to SC criteria.	

Evaluation Criteria	Discussion	Reference
11 - Other Credited Functional Requirements		
11.1 Address any specific functional requirements for the confinement ventilation system (beyond the scope of those above) credited in the DSA.	[DOE Guidance Document does not provide any specific evaluation guidance discussion for this criteria]	10 CFR 830, Subpart B
	None <u>Gap Analysis</u> No Gap	

Evaluation Criteria	Discussion	Reference
0 - Ventilation System Description & References		
0.1 System Description	N/A	N/A
	System Description The Cell Block Exhaust (CE) systems are two independent systems serving Section E Shielded Cell Blocks A&B. Cell Block A includes six shielded cells. Cell Block B includes ten shielded cells and two gloveboxes. The Cell Block Exhaust systems are the primary exhaust system for Section E. All Cell exhaust is triple HEPA filtered before discharge to the Sand Filter. Each CE system consists of two exhaust fans (one normally operating and one in standby). Reference Attachment 11 Figure A for a system single line. One fan in each system (Fans A1 and B2) is configured to receive an alternate power feed if needed. In the event of a loss of power, standby power is provided to all four fans by the 773-A Diesel Generator. While the Shielded Cells have been qualified to PC-3 for NPH events, the surrounding building structures that support the ventilation equipment (including the Cell Exhaust system) are only qualified to PC-1.	

Evaluation Criteria	Discussion	Reference
0.2 System References	N/A System Design Descriptions o G-SYD-A-00004, Cell Block Exhaust System Design Description o M-SYD-A-00022, HVAC Supply and Miscellaneous Exhaust System Design Description o G-SYD-A-00006, SRTC Area Shielded Cells System Design Description o G-SYD-A-00002, SRNL Sand Filter System Design Description o M-SYD-A-00024, IA, PLTA & Compressor Alternate CW o E-SYD-A-00008, 773-A D/G Standby Power System Drawings o ST5-14557, Exhaust System for HLC, Cells 7-16 o ST5-19471, A Cell Block Exhaust Equip. Arrgt. , Cells 1-6 o M-M6-A-0204, A Cell Exhaust Cells 1 thru 6 P&ID o M-M6-A-0205, B Cell Exhaust Cells 7 thru 12 P&ID o M-M6-A-0206, B Cell Exhaust Fans P&ID o M-M6-A-0207, B Cell Exhaust Cells 13 thru 16 P&ID Test Procedures o TO-06-019, Functional Test of Section E Cell Block Exhaust Interlocks and Alarms o TO-06-025, Functional Test of Shielded Cell Blocks A & B Exhaust System Fans o 5Q1.2, Procedure 484, Building Air Survey o TO-05-027, 773-A D/G Annual Design Load Test Round Sheets and Other Procedures o ROD-OPS-2002-002 - Control Area Operator (CAO) Round Sheets o ROD-OPS-2002-003 - Facility Operator (FO) Round Sheets o AOP-06-007, Wildland Fire, Facility Ventilation Shutdown and/or Evacuation o AOP-06-002, Loss of Ventilation, A Cell Block o AOP-06-003, Loss of Ventilation, B Cell Block o TE-48-042, Calibration of Cell Exhaust Flow Indicators Standards o DuPont Engineering Specifications 3027, 3017, 5998, 7591, 8728, H16J, SH1A. o SRS Procurement Specification M-SPP-G-00243, HEPA Filter Specification o SRS Engineering Standard 15888, HEPA Filter Requirements o DOE-STD-3020-2005, DOE Technical Standard - Specification for HEPA Filters Used by DOE Contractors o DOE-STD-3025-2007, DOE Technical Standard - Quality Assurance Inspection and Testing of HEPA Filters o UL 586, UL Standard for Safety, High Efficiency, Particulate, Air Filter Units, 1996 o ANSI/ASME NQA-1, Quality Assurance Program Requirements for Nuclear Facilities Miscellaneous o Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, January 2006 o 2004-2 Ventilation System Evaluation Guidance Addendum, March 2007 o SRNL-ROE-2007-00063, SRNL Table 4-3 Submittal to DOE-SR, April 2007 o WSRC-SA-2, SRNL Technical Area (TA) Documented Safety Analysis (DSA), Revision 3	N/A

Evaluation Criteria	Discussion	Reference
	o WSRC-TS-97-00014, SRNL Technical Area (TA) Technical Safety Requirements (TSRs), Revision 4 o SRNL-ESD-2007-00017, Structural Integrity Program Scope, Resources & Estimate, February 2007	

Evaluation Criteria	Discussion	Reference
	1 - Ventilation System – General Criteria	
1.1 Pressure differential should be maintained between zones and atmosphere.	Number of zones as credited by accident analysis to control hazardous material release; demonstrate by use considering potential in-leakage. The Section E zone flows and ventilation system interactions are described in the specific SDD documents (see references). To evaluate ventilation system performance, air balance tests are periodically conducted for E-Section ventilation systems and compared to design basis flows. Optimal air movement between confinement zones is verified (tertiary-to-secondary-to-primary). Results are documented in an Air Balance Test Report. Key system parameters are recorded on a daily and weekly basis (operator rounds) which allows monitoring of ventilation system function and performance. The Section E, A Cellblock and B Cellblock exhaust systems are currently operated at minimum flows of 2100 CFM and 3400 CFM respectively, approximately 60% of cell volume per minute. The robust cell exhaust flows provide adequate differential pressure between the cells and the adjacent spaces such that a positive airflow is maintained into the primary confinement zones from the secondary confinement zones. Confinement Zones o Primary Confinement — Shielded Cells / Gloveboxes / Ducting through 1st testable HEPA filter stage o Secondary Confinement — Cell Operating & Service Areas / Cell roof / HEPA filter room o Tertiary Confinement — Corridors / Offices / General Service Floor Area Confinement zones as a ventilation system design basis are not credited in the facility DSA. Minimum CE system flows to provide confinement of the cell contents are maintained as directed by the facility TSR's. <u>Gap Analysis</u> No Gap - The cells are maintained as primary confinement zones.	DOE-HDBK-1169 (2.2.9) ASHRAE Design Guide
1.2 Materials of construction should be appropriate for normal, abnormal and accident conditions.	[DOE Guidance Document does not provide any specific evaluation guidance discussion for this criteria] Section E CE Systems exhaust air from shielded cells which may contain highly radioactive material. CE ducting extends from the shielded cells to the Cell Exhaust fans located on the roof of Section E. All cell exhaust is triple-HEPA filtered and discharged to the FHSF inlet ducting. For Cell Block B, ducting from the cells to the 3rd stage filter housing is 16 ga. 304L SS. HEPA filter housings are 304L SS. Ducting from the last HEPA filter housing to the fans is 16 ga. galvanized steel. For Cell Block A ducting is 16 ga. 304L SS. Flange gaskets are 1/8" neoprene. Flexible connections at the fan suction are per DuPont Std. H16J. Blast gate damper is 304L SS. Fans are coated carbon steel. The CE fans discharge to the Sand Filter inlet ducting (stainless steel). <u>Gap Analysis</u> No Gap - All materials of construction are appropriate for normal, abnormal and accident conditions. Inspections conducted as part of the Structural Integrity Program on the inside of the Section E HEPA ductwork to date have shown no reasons why the ventilation system cannot perform it's intended function during all conditions.	DOE-HDBK-1169 (2.2.5) ASME AG-1

Evaluation Criteria	Discussion	Reference
1.3 Exhaust system should withstand anticipated normal, abnormal and accident system conditions and maintain confinement integrity.	As required by accident analysis to prevent accident release.	DOE-HDBK-1169 (2.4) ASHRAE Design Guide
	The CE systems are designed to maintain the primary confinement zones at a negative pressure with respect to surrounding areas such that a positive airflow is maintained into the primary confinement zones from the secondary confinement zones. During normal operation these multiple systems run continuously within defined performance parameters to maintain the proper confinement air flow. All exhaust air flows are filtered through HEPA filters. The CE systems exhaust to the Sand Filter (FHSF) system. The ventilation system components are adequate for normal and abnormal conditions. Abnormal conditions include power failure, partial shutdown, removal of a Cell Cover or Roof Plug, changing of in-cell HEPA filters, manipulator replacement, or activation of the Cell Block A or Cell Block B Halon fire suppression system. In the event of a power failure, all CE fans are provided with Standby power from the 773-A Diesel Generator. In case the primary switchgear requires maintenance, an alternate power feed is available for fans A1 and B2. Operating procedures are in place to maintain confinement ventilation in the event of the removal of a Cell Cover or Roof Plug, changing of in-cell HEPA filters, or manipulator replacement. Regarding activation of the cell block Halon fire suppression systems, the Halon discharge rates have been evaluated and are less than minimum cell flow rate. The following accident scenarios are considered. Process Explosion - Unstable Lab Chemical or Accumulation of Process Flammable Gas or VOCs with no consequential fire - Ventilation systems would operate normally to maintain a positive pressure differential into the effected cells. Exhaust flows through HEPA filtration are believed adequate to contain mobilized contaminants. If the HEPA plugs, the contaminants would be contained within the cells and ductwork. If the HEPA is compromised the exhaust air would pass through to the Sand Filter. If a filter housing or ducting is compromised, the RREX (Exhaust) systems would contain the contamination. Lab/Cell walls, Gloveboxes, and ductwork would passively contain contaminants. Explosion - Glovebox Overpressurization - same as above. Explosion - Accumulation of Distributed Flammable Gas with no consequential fire - Not applicable. Distributed flammable gas is not supplied to the shielded cells. Drop / Spill - The CE system flow is sufficient to mitigate chemical spills inside the cells. Exhaust flows through HEPA filtration are adequate to contain mobilized contaminants. <u>Gap Analysis</u> No Gaps	

Evaluation Criteria	Discussion	Reference
1.4 Confinement ventilation systems shall have appropriate filtration to minimize release.	Address: 1) Type of filter (e.g., HEPA, sand, sintered metal); 2) Filter sizing (flow capacity and pressure drop); 3) Decontamination Factor vs. accident analysis assumptions. Nuclear Grade HEPA filters are procured to SRS Specification M-SPP-G-00243 which incorporates the requirements of ASME AG-1. The cell exhaust is filtered by two stages of individually tested HEPA filters in series periodically leak tested in place to confirm a filter housing filtration efficiency of 99.95%. This efficiency was qualitatively selected to ensure that the HEPA filter is properly installed to support the passive confinement function. Prior to receipt the filters are tested at the Independent Filter Testing Facility (FTF) to confirm an efficiency of at least 99.97% for a decontamination factor DF = 3333. Decontamination factor has not been considered in the facility DSA. The filters are credited with confinement function only, not dose reduction. The exhaust from Cell Block A discharges from Cells 2, 4 & 6. Each of these cells have an in-cell dust cover and 1st stage HEPA filter. This first stage HEPA filter functions as a prefilter. The three exhaust streams discharge to three single stage HEPA filters. Each flow path normally operates at 1000 cfm. A common plenum caries the 2nd stage filter exhaust to three parallel single stage HEPA filters on the main floor. The 3rd stage exhaust discharges to the FHSF. The exhaust from Cell Block B discharges from Cells 8,10,12,14,15, & 16. Each of these cells have an in-cell dust cover and 1st stage HEPA filter. This first stage HEPA filter functions as a prefilter. The six exhaust streams discharge to six single (second) stage HEPA filters. Each flow path normally operates at 750 cfm. A common plenum caries the 2nd stage exhaust and the exhaust from two manipulator decon gloveboxes to two parallel, single stage filter banks in a main floor filter room. The 3rd stage filters exhaust discharges to the FHSF. HEPA Filters used are listed below. 1st stage In-Cell HEPA Filter Cell Block A - 24" X 24" X 11.5" fluid seal -rated flow @ 1" wc DP- 1500 CFM Cell Block B Cells 8, 10, & 12 - 24" X 24" X 5-7/8" Type II - rated flow @ 1" wc DP- 500 CFM Cell Block B Cells 14, 15, & 16 - 24" X 24" X 5-7/8" Type I - rated flow @ 1" wc DP- 500 CFM 2nd stage HEPA Filter Cell Block A - 24" X 24" X 11.5" metal frame, fluid seal - rated flow @ 1" wc DP- 1000 CFM Cell Block B - 24" X 24" X 5-7/8" Flanders Type G-1 housing- rated flow @ 1.3" wc DP- 1500 CFM 3rd stage HEPA Filter Cell Block A - 24" X 24" X 11.5" metal frame, fluid seal - rated flow @ 1" wc DP- 1000 CFM Cell Block B - 24" X 24" X 11.5" wood frame, fluid seal - rated flow @ 1" wc DP- 1000 CFM Cell Block B 1st stage HEPA filters have a combined rated airflow capacity of 3000 cfm. This is less than the normal operating airflow the filter rating (3400 and 4500 cfm). The filters function as a nuclear grade prefilter (i.e. not credited in the DSA), is not in-place tested and is followed by two stages of in-place tested HEPA filters and a sand filter. For this reason, this filter sizing anomaly has not been identified as a gap.	ASME AG-1 DOE-HDBK-1169 (2.2.1)

Evaluation Criteria	Discussion	Reference
	Gap Analysis Gap Number 23: Discretionary Gap - Cell Block B 3rd stage HEPA filter airflow is greater than the filter rating during individual HEPA filter isolation. Gap Number 24: Discretionary Gap - Cell Block A 2nd stage HEPA filters and Cell Block A 3rd stage HEPA filter airflow is greater than the filter rating during individual HEPA filter isolation.	

Evaluation Criteria	Discussion	Reference
	2 - Ventilation System – Instrumentation & Control	
2.1 Provide system status instrumentation and/or alarms.	Address key information to ensure system operability (e.g., system delta-P, filter pressure drop).	ASME AG-1 DOE-HDBK-1169 ASHRAE Design Guide (Section 4)
	The Section E CE fans (two fans per section) are instrumented on the cabinet status boards in the C041 CR to show fan status and permit fan starting and stopping. Each cell exhaust branch (3 in A Cell Block, 6 in B Cell Block) have low flow alarms that display in the C041 CR. Cell Block A exhaust has pitot tube array flow instrumentation installed in each of the three exhaust branches. Cell block B exhaust has a pitot tube array instrumentation in the main exhaust duct indicating total cell block flow. These instruments and their associated indicators are credited in the DSA for verifying TSR operational parameters of the systems. Each cell block is equipped with a differential pressure indicator for cell to operating area DP. The system HEPA filter housings are provided with the following instrumentation: Cell Block A 2nd stage - flow indicator Cell Block B 2nd stage - DP indicators; flow indicator Cell Block A 3rd stage - none Cell Block B 3rd stage -none <u>Gap Analysis</u> Gap Number 25: Discretionary Gap - Cell Block A 2nd Stage HEPA Filters, Cell Block A 3rd stage HEPA filters and Cell Block B 3rd Stage HEPA filters are not provided with differential pressure indicators.	
2.2 Interlock supply and exhaust fans to prevent positive pressure differential.	[DOE Guidance Document does not provide any specific evaluation guidance discussion for this criteria]	DOE-HDBK-1169 ASHRAE Design Guide (Section 4)
	Section E supply and exhaust fans are not interlocked. If the CE system were to shut down, Section E would become pressurized with respect to adjacent building areas and the outside environment. Since no supply air is provided directly into the cells, a primary confinement zone airflow reversal would not occur. Alarm response procedures (ARP) and Abnormal Operating Procedures (AOP) include steps to shutdown the appropriate HVAC/Supply units to correct the pressure differential between the secondary and tertiary confinement zones. <u>Gap Analysis</u> Gap Number 26: Discretionary Gap - Interlocks are not provided between the supply and exhaust systems.	

Evaluation Criteria	Discussion	Reference
2.3 Post accident indication of filter break-through.	Instrumentation supports post accident planning and response; should be considered critical instrumentation for SC.	TECH-34
	The Section E CE system has duct sampling stations between the 1st Stage (in-cell) and 2nd Stage (1st testable stage) HEPA Filter housing that are sampled on a weekly basis. This provides routine and post event indication of filter break-through. The system then discharges to the SRNL Sand Filter which is equipped with both an inlet and outlet monitoring system which reports to the SRNL control room. See attachment 9 Evaluation Criteria 2.3 for addtional detail. <u>Gap Analysis</u> No Gap	
2.4 Reliability of control system to maintain confinement function under normal, abnormal and accident conditions.	Address, for example, impacts of potential common mode failures from events that would require active confinement function.	DOE-HDBK-1169 (2.4)
	Section E CE systems each contain two parallel exhaust fans controlled from the C041 Control Room. Normally one fan operates continuously (lead) and one fan is in standby. If either exhaust plenum static pressure drops to 2 in wc the primary fan is de-energized and the standby fan is energized. If the A Cell Block exhaust fan inlet plenum drops below 2" wc vacuum, an alarm will sound in the control room. If the B Cell Block exhaust fan inlet plenum drops below 1" wc vacuum, an alarm will sound in the control room and in the cell block operating area. Abnormal operations include lead fan failure, loss of power and control system failure. In the event of power failure, standby power is provided to all four CE fans. In the event of lead fan failure, the standby fan will start. In the event of control system failure, one fan in each cell block can be manually switched to an alternate power feed which operates from a local stop/start station. The Sections E CE exhaust systems each have redundant fans that are powered with standby power. Operation of the systems is controlled by operating procedures. System control is maintained during abnormal and accident conditions by Abnormal Operating Procedures (AOPs) and Alarm Response Procedures (ARPs). <u>Gap Analysis</u> No Gap.	

Evaluation Criteria	Discussion	Reference
2.5 Control components should fail safe.	[DOE Guidance Document does not provide any specific evaluation guidance discussion for this criteria] The Section E CE fan controls are fail safe- if a fan fails, the standby fan will come on line. The A Cell Block fan discharge dampers are pneumatically operated and close when the associated fan fails. The B Cell Block fan discharge dampers are gravity operated and close upon fan failure. In case of loss of the Instrument Air system, the air operated A Cell Block fan inlet dampers will fail closed. The A Cell Block Exhaust Failure Alarm will sound in the main control room. Shielded Cells Operations will be advised to stop all in-cell activites. Both Cell Block Exhaust Failure Alarms will sound in the main control room. Loss of instrument air will cause the cell outlet dampers for both cell blocks to fail closed. This is the desired failure mode to ensure that a positive pressure event in the Sand Filter inlet duct does not backflow contamination from the cells to the operating and maintenance areas. Loss of airflow caused by the dampers failing closed will alarm in the main control room. Gap Analysis No Gap - Control components for the Section E CE systems are fail-safe.	DOE-HDBK-1169 (2.4)

Evaluation Criteria		Discussion	Reference
3 - Resistance to Internal Events – Fire			
3.1	Confinement ventilation systems should withstand credible fire events and be available to operate and maintain confinement.	Required for new facilities; as required by the accident analysis for existing facilities (discretionary). Must address protection of filter media.	DOE-HDBK-1169 (10.1) DOE-STD-1066
		As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Page 21 and 22 Discussion, the evaluation of internal fire events for an existing facility is only required if the accident analysis takes credit for the active confinement ventilation system.	
3.2	Confinement ventilation systems should not propagate spread of fire.	Required for new facilities; as required by the accident analysis for existing facilities (discretionary). Address fire barriers, fire dampers arrangement.	DOE-HDBK-1169 (10.1) DOE-STD-1066
		As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Page 21 and 22 Discussion, the evaluation of internal fire events for an existing facility is only required if the accident analysis takes credit for the active confinement ventilation system.	

Evaluation Criteria	Discussion	Reference
4 - Resistance to External Events – Natural Phenomena – Seismic		
4.1 Confinement ventilation systems should safely withstand earthquakes.	If the active CVS system is not credited in a seismic accident condition there is no need to evaluate that performance and/or design attribute for the confinement ventilation system (discretionary). Also, any seismic impact on the confinement ventilation system performance will be based on the current functional requirements in the DSA. NOTE: Seismic requirements may apply to Defense-in-Depth items indirectly for the protection of safety SSCs. As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per 2004-2 Ventilation System Evaluation Guidance Addendum, March 6, 2007, Caution 4 and Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Page 22 Discussion, the evaluation of seismic events is only required if the accident analysis takes credit for the active confinement ventilation system during or after the NPH event.	ASME AG-1 (AA) DOE O 420.1B DOE-HDBK-1169 (9.2)

	Evaluation Criteria	Discussion	Reference
		5 - Resistance to External Events – Natural Phenomena – Tornado/Wind	
5.1	Confinement ventilation systems should safely withstand tornado depressurization.	If the active CVS is not credited in a tornado condition there is no need to evaluate that performance and/or design attribute for the confinement ventilation system (discretionary). Also, any tornado impact on the confinement ventilation system performance will be based on the current functional requirements in the DSA.	DOE O 420.1B DOE-HDBK-1169 (9.2)
		As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per 2004-2 Ventilation System Evaluation Guidance Addendum, March 6, 2007, Caution 4 and Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Pages 22 and 23 Discussion, the evaluation of tornado and wind events is only required if the accident analysis takes credit for the active confinement ventilation system during or after the NPH event.	
5.2	Confinement ventilation systems should withstand design wind effects on system performance.	If the active CVS is not credited in a wind condition there is no need to evaluate that performance and/or design attribute for the confinement ventilation system (discretionary). Also, any wind impact on the confinement ventilation system performance will be based on the current NP analysis in the DSA.	DOE O 420.1B DOE-HDBK-1169 (9.2)
		As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per 2004-2 Ventilation System Evaluation Guidance Addendum, March 6, 2007, Caution 4 and Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Pages 22 and 23 Discussion, the evaluation of tornado and wind events is only required if the accident analysis takes credit for the active confinement ventilation system during or after the NPH event.	

	Evaluation Criteria	Discussion	Reference
		6 - Other NP Events (eg. flooding, precipitation)	
6.1	Confinement ventilation system should withstand other NP events considered credible in the DSA where the confinement ventilation system is credited.	If the active confinement ventilation system is not credited for this event there is no need to evaluate that performance and/or design attribute for the confinement ventilation system (discretionary). Also, any impact on the confinement ventilation system performance will be based on the current NP analysis in the DSA.	DOE O 420.1B DOE-HDBK-1169 (9.2)
		As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per 2004-2 Ventilation System Evaluation Guidance Addendum, March 6, 2007, Caution 4 and Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Page 23 Discussion, the evaluation of other NPH events is only required if the accident analysis takes credit for the active confinement ventilation system during or after the NPH event.	

Evaluation Criteria	Discussion	Reference
7 - Range Fires / Dust Storms		
7.1 Administrative controls should be established to protect confinement ventilation systems from barrier threatening events.	Ensure appropriately thought out response to external threat is defined (e.g. pre-fire plan).	DOE O 420.1B
	The Savannah River Forestry Department is responsible for fire fighting efforts in regards to wildland fires. They also have a program of controlled burns and mechanical thinning of underbrush to limit or prevent wildland fires spreading out of control. If the fire encroaches upon SRNL, the Savannah River Site Fire Department will direct extinguishing efforts. Building 773-A has a current Fire Pre Plan and has procedures to reduce confinement ventilation system air flow (originally develop for electrical system maintenance) that will minimize soot loading of the filters in the ventilation systems. Reference: AOP-06-007 Dust storms are not an issue at the Savannah River Site due to the regional climate. <u>Gap Analysis</u> No Gap. Administrative controls are sufficient to protect the confinement ventilation systems for barrier threatening events.	

Evaluation Criteria	Discussion	Reference
8 - Testability		
8.1 Design supports the periodic inspection and testing of filters and housing, and test and inspections are conducted periodically.	Ability to test for leakage per intent of N510. 2nd and 3rd stage HEPA filter housings have the capability for in-place testing. The HEPA Filter Testing Program requires HEPA filters in active radiological service to be changed periodically. They will also be assessed for material buildup following a process event. (Triggered by SIRIM criteria.) 2nd and 3rd stage CE HEPA filter are tested every 18 months to verify that they have an efficiency of greater or equal to 99.95%. <u>Gap Analysis</u> No Gap - Design supports periodic filter testing and inspection and inspections are conducted periodically.	DOE-HDBK-1169 (2.3.8) ASME AG-1 ASME N510
8.2 Instrumentation required to support system operability is calibrated.	Credited instrumentation should have specified calibration / surveillance requirements. Non-safety instrumentation should be calibrated as necessary to support system functionality. Magnehelic flow indicators used to perform TSR Surveillance Requirements are calibrated on an 18 month frequency. Pressure switches associated with the low pressure alarm and interlock system are calibrated on a 24 month frequency. Non-safety instrumentation is calibrated on an as-needed basis. <u>Gap Analysis</u> No Gap	DOE-HDBK-1169 (2.3.8)

Evaluation Criteria	Discussion	Reference
8.3 Integrated system performance testing is specified and performed.	Required responses assumed in the accident analysis must be periodically confirmed including any time constraints.	DOE-HDBK-1169 (2.3.8)
	Airflow direction is verified at key points within the building during periodic air balance testing to verify that the ventilation systems are functioning as intended. Findings are forwarded to the Design Authority Engineer. System airflow and differential pressures are monitored and recorded as part of normal operator rounds. No functional testing is required by the TSR of the CE systems, however the alarm and standby fan circuits are tested on a periodic basis (See Section 0.2 for references). Gap Analysis No Gap	

Evaluation Criteria	Discussion	Reference
9 - Maintenance		
9.1 Filter service life program should be established.	Filter life (shelf life, service life, total life) expectancy should be determined. Consider: filter environment, maximum delta-P, radiological loading, age, and potential chemical exposure. Per requirements of SRS Engineering Standard 15888, a Filter service life program has been established for this system. This standard is the basis of the Nuclear Air Cleaning Handbook Appendix C. The filters have a maximum shelf life of 3 years and total life of 10 years. Program is tracked using the Computerized Maintenance Management System . In-Cell (or 1st stage) HEPA filters typically are in service for approx three years until dust loading requires replacement of the filters. This has been found to bound any degradation due to radiation or temperature. <u>Gap Analysis</u> No Gap	DOE-HDBK-1169 (3.1 & App C)

Evaluation Criteria	Discussion	Reference
10 - Single Failure		
10.1 Failure of one component (equipment or control) shall not affect continuous operation.	Address potential failures (example failures - fan, backup power supply, switchgear). Each CE system is aligned with two operable fans; one in standby to provide redundancy. A fan failure is indicated as an alarm in the main control room. The standby fan starts automatically to restore full system operability. In the event of a power failure, standby power will be provided to all Section E CE fans, but they must be manually restarted from the Control Room. The two CE fans for each cell exhaust system are powered from the same motor control center. Both fans in each system will be inoperable if the respective MCC is deenergized. One fan in each system may be manually switched to an alternate MCC. However automatic switching or separate power sources for all CE fans would be needed for continuous operation after loss of an MCC. Fan operation is not credited in the facility DSA to prevent or mitigate a design basis accident, but continued system operability following an MCC loss is an element of an "active confinement system". Gap Analysis Gap Number 27: Discretionary Gap - The two sub-systems are powered from the same MCC from the same D/G Gap Number 58: Discretionary Gap - The two sub-systems are powered by a single control transforner for each sub-system.	DOE O 420.1B (Facility Safety, Chapter I, Sec. 3.b(8))
10.2 Automatic backup electrical power shall be provided to all critical instruments and equipment required to operate and monitor the confinement ventilation system.	[DOE Guidance Document does not provide any specific evaluation guidance discussion for this criteria] The 773-A standby diesel generator automatically supplies backup power to the CE fans and control equipment upon a loss of normal power. The control room CE fan failure alarms and fan status indicators are provided with automatic back-up power. The system backup power feature is not credited in the DSA with a preventive or mitigative function following a design basis accident. Gap Analysis No Gap	DOE-HDBK-1169 (2.2.7)
10.3 Backup electrical power shall be provided to all critical instruments and equipment required to operate and monitor the confinement ventilation system.	NOTE: Safety Class is addressed through previous line. This evaluation criteria is NOT APPLICABLE, as it is an SS-only criteria. SRNL confinement ventilation systems are evaluated to SC criteria.	DOE-HDBK-1169 (2.2.7)

Evaluation Criteria	Discussion	Reference
11 - Other Credited Functional Requirements		
11.1 Address any specific functional requirements for the confinement ventilation system (beyond the scope of those above) credited in the DSA.	[DOE Guidance Document does not provide any specific evaluation guidance discussion for this criteria] None Gap Analysis No Gap	10 CFR 830, Subpart B

Evaluation Criteria	Discussion	Reference
0 - Ventilation System Description & References		
0.1 System Description	N/A <u>System Description</u> The Section E Regulated Room Exhaust (E-RREX) System consists of four independent sub-systems that exhaust various locations in Section E. All four E-RREX sub-systems discharge to the SRNL Sand Filter inlet duct on the Section E roof. Reference Attachment 11 Figure A for a system single line. <u>E-RREX MDF Exhaust Sub-system</u> Three (3) E-RREX Fans exhaust the Manipulator Decontamination Facility (Room E-063) and the Shielded Storage Room (Room E-061) using single-stage HEPA filtration, with a separate filter at each fan inlet. Each fan has a capacity of 1200 CFM at 6.6 inwc vacuum. The two room exhaust ducts are cross tied and configured such that the three fans are installed in parallel. Normal operation is two fans running with one in standby. All three fans are provided with both normal and backup power. If one of the normally running fans fails, alarms activate locally in the Section E cell operating area and remotely in the C041 Control Room. The standby fan is started manually from a local control panel in Section E Room E-065. <u>E-RREX High Bay Exhaust Sub-system</u> Two (2) E-RREX Fans exhaust the High Bay Loading Area (Room E-079) using single-stage HEPA filtration, with one filter at each of the two fan inlets. Normal operation is one fan running with the other in standby. Both fans are supplied with normal power only. If the normally running fan fails, alarms activate locally in the Section E cell operating area and remotely in the C041 Control Room. Note - the High Bay Loading Area is also exhausted by the E-LHEX system, which is covered in a separate Table 5-1. <u>E-RREX Lab and Storage Exhaust Sub-system</u> Two (2) E-RREX Fans exhaust Laboratory and Storage Rooms E-041, E-043, E-045, E-047, and F-080 using single-stage HEPA filtration, with each room having a local HEPA filter at its room exhaust duct inlet. Normal operation is one fan running with the other in standby. Both fans are supplied with normal power only. If the normally running fan fails, alarms activate locally in the Section E cell operating area and remotely in the C041 Control Room. The standby fan is started manually from a local control panel in Room E-001. <u>E-RREX Fan Room Exhaust Sub-system</u> One (1) E-RREX Fan exhausts the E-131 Fan Room using single-stage HEPA filtration, with one filter at the room exhaust duct inlet. There is no alarm to indicate fan room exhaust failure. The building shell, walls and roof associated with the RREX systems are qualified to PC-1.	N/A

Evaluation Criteria	Discussion	Reference
0.2 System References	N/A System Design Descriptions o M-SYD-A-00022, 773-A Section E, HVAC Supply and Miscellaneous Exhaust o M-SYD-A-00024, IA, PLTA & Compressor Alternate CW o E-SYD-A-00008, 773-A D/G Standby Power System o G-SYD-A-00002, SRNL Sand Filter System Design Description Drawings o M-M5-A-0206, Section E Exhaust Systems Air Balance Riser Diagram o W144392, Basic Design Manual Section E H&V Flow Diagram o P-PH-A-0076, High Level Caves Supply and Exhaust Systems Air Flow and Balance o M-M6-A-0164, Manipulator Decontamination Facility Exhaust System P&ID Test Procedures o TP-02-773A-EWING-01, Section E Air Balance Test Procedure o 5Q1.2, Procedure 484, Building Air Survey o TO-05-027, 773-A D/G Annual Design Load Test Round Sheets and Other Procedures o ROD-OPS-2002-002 - Control Area Operator (CAO) Round Sheets o ROD-OPS-2002-003 - Facility Operator (FO) Round Sheets o AOP-06-007, Wildland Fire, Facility Ventilation Shutdown and/or Evacuation Standards o DuPont Engineering Specifications 3027, 3017, 5998, 7591, 8728, H16J, SH1A. o SRS Procurement Specification M-SPP-G-00243, HEPA Filter Specification o SRS Engineering Standard 15888, HEPA Filter Requirements o DOE-STD-3020-2005, DOE Technical Standard - Specification for HEPA Filters Used by DOE Contractors o DOE-STD-3025-2007, DOE Technical Standard - Quality Assurance Inspection and Testing of HEPA Filters o UL 586, UL Standard for Safety, High Efficiency, Particulate, Air Filter Units, 1996 o ANSI/ASME NQA-1, Quality Assurance Program Requirements for Nuclear Facilities Miscellaneous o Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, January 2006 o 2004-2 Ventilation System Evaluation Guidance Addendum, March 2007 o SRNL-ROE-2007-00063, SRNL Table 4-3 Submittal to DOE-SR, April 2007 o WSRC-SA-2, SRNL Technical Area (TA) Documented Safety Analysis (DSA), Revision 3 o WSRC-TS-97-00014, SRNL Technical Area (TA) Technical Safety Requirements (TSRs), Revision 4 o SRNL-ESD-2007-00017, Structural Integrity Program Scope, Resources & Estimate, February 2007	N/A

Evaluation Criteria	Discussion	Reference
1 - Ventilation System – General Criteria		
1.1 Pressure differential should be maintained between zones and atmosphere.	Number of zones as credited by accident analysis to control hazardous material release; demonstrate by use considering potential in-leakage. Confinement Zones o Primary Confinement — Shielded Cells / Gloveboxes / Ducting through 1st testable HEPA filter stage o Secondary Confinement — Cell Operating & Service Areas / Cell roof / HEPA filter room / Fan Room o Tertiary Confinement — Corridors / Offices / General Service Floor Area See Table 5-1 for the Cell Exhaust System for a discussion of the Section E primary confinement zones. The E-RREX exhaust systems serve secondary confinement zones only. Secondary confinement zones consist of the cell large equipment loading area (high bay), cell small equipment loading areas, manipulator glovebox room, offices, change/restrooms and cell operating areas. These areas have a limited quantity of direct supply air; the major portion is drawn from the tertiary confinement zone. These areas have a number of direct exhaust systems for locations with a higher contamination potential. Tertiary confinement zones consist of office, storage, maintenance and support spaces surrounding the secondary confinement zone. The spaces have a mixture of recirculating HVAC systems, 100% outside air HVAC systems and unfiltered exhaust systems. Differential pressures between zones are not measured directly, but instead are maintained by periodic monitoring of air flow, and by periodic performance of air flow balance tests. Air flow direction checks are performed quarterly per Manual 5Q1.2 - 484. Air balance tests are performed periodically to ensure proper air flows and room differential pressures. The last such test for Section E was performed in 2001. The E-RREX MDF Exhaust Sub-system fans are equipped with variable frequency drives to regulate the speed of E-RREX Fans 1, 2 and 3 to maintain constant air flow as the pre-filter and HEPA filter pressure drop increases over time due to filter loading. The E-RREX High Bay Exhaust Sub-system is equipped with a pneumatically controlled static pressure compensation system to maintain constant air flow as the pre-filter and HEPA filter pressure drop increases over time due to filter loading. The E-RREX Lab and Storage Exhaust Sub-system is equipped with a flow velocity pressure compensation system to maintain constant air flow as the pre-filter and HEPA filter pressure drop increases over time due to filter loading. <u>Gap Analysis</u> No Gap.	DOE-HDBK-1169 (2.2.9) ASHRAE Design Guide

Evaluation Criteria	Discussion	Reference
1.2 Materials of construction should be appropriate for normal, abnormal and accident conditions.	[DOE Guidance Document does not provide any specific evaluation guidance discussion for this criteria]	DOE-HDBK-1169 (2.2.5) ASME AG-1
	All ductwork is either 16 or 22 gauge galvanized carbon steel, except the Fan Room Exhaust sub-system which is stainless steel. Where flanged joints are used, they are sealed with neoprene gaskets. All fans are carbon steel with protective coating, with flexible connections at the fan inlet and outlet. HEPA filter housings are stainless steel. Gap Analysis No Gap. Materials of construction are appropriate for normal, abnormal and accident conditions.	
1.3 Exhaust system should withstand anticipated normal, abnormal and accident system conditions and maintain confinement integrity.	As required by accident analysis to prevent accident release.	DOE-HDBK-1169 (2.4) ASHRAE Design Guide
	The E-RREX system functional classification is General Service; it is not credited in the DSA to perform a safety function. The events to be evaluated for Section E are (1) a drop/spill inside a Section E shielded cell, and (2) a low-energy process explosion inside a Section E shielded cell or laboratory, caused by an unstable lab chemical, process flammable gas or VOCs. The Lab and Storage Exhaust sub-system exhausts a Section E laboratory and storage areas, therefore would provide non-credited dose reduction for a low-energy process explosion inside a laboratory. The laboratories are exhausted via wall-mounted HEPA filter enclosures, which may be vulnerable to penetration of the filter by a missile from an explosion. The design of the HEPA enclosure access doors with an expanded metal screen in front of the HEPA filter, serves to provide adequate protection of the filters. Because of an extremely low source term in the secondary zones of Section E, the evaluated events are not credible for this subsystem. Gap Analysis No Gap.	

Evaluation Criteria	Discussion	Reference
1.4 Confinement ventilation systems shall have appropriate filtration to minimize release.	Address: 1) Type of filter (e.g., HEPA, sand, sintered metal); 2) Filter sizing (flow capacity and pressure drop); 3) Decontamination Factor vs. accident analysis assumptions. Nuclear Grade HEPA filters are procured to SRS Specification M-SPP-G-00243 which incorporates the requirements of ASME AG-1. Each E-RREX exhaust sub-system utilizes single stage HEPA filters periodically leak tested in place to confirm a filter housing filtration efficiency of 99.95%. Each system is discharged to the SRNL sand filter. Prior to receipt the filters are tested at the Independent Filter Testing Facility (FTF) to confirm an efficiency of at least 99.97% for a decontamination factor DF = 3333. Decontamination factor has not been considered in the facility DSA. The measured air flows for the E-RREX sub-systems are compared to the HEPA filters nominal sizes and capacity ratings specified by ASME AG-1, Section FC: MDF Exhaust- size and rating: 24"x24"x11.5", 1500 CFM max. measured flow branch- 935 CFM High Bay Exh.- size and rating: 24"x30"x11.5", 1250 CFM measured flow - 1673 CFM Lab&Stor Exh.- size and rating: 24"x24"x11.5", 1000 CFM max. measured flow branch- 1101 CFM Fan Rm. Exh.- size and rating: 24"x24"x11.5", 1000 CFM (x3) measured flow - 700 CFM HEPA filters are replaced when the pressure drop increase above the maximum operating point assumed when the system was designed. this varies between 2.5 and 5 inches wc based on the individual system. The High Bay exhaust and Lab & Storage exhaust (from E041 hood) exceed the nominal capacity ratings. The High Bay Exhaust sub-system uses 1950's style "tape-in-place" configured HEPA filter mounting assemblies in lieu of enclosed filter housings. Tape forms a part of the confinement barrier and the wooden filter case is exposed to local hazards including fire . This style housing is highly dependent upon the skill of the worker to properly install and seal the HEPA filter. Gap Analysis Gap Number 39: Discretionary Gap - Two locations have airflow greater than the rated capacity of the HEPA filter.	ASME AG-1 DOE-HDBK-1169 (2.2.1)

Evaluation Criteria	Discussion	Reference
2 - Ventilation System – Instrumentation & Control		
2.1 Provide system status instrumentation and/or alarms.	Address key information to ensure system operability (e.g., system delta-P, filter pressure drop).	ASME AG-1 DOE-HDBK-1169 ASHRAE Design Guide (Section 4)
	E-RREX MDF Exhaust Sub-system Local instrumentation - HEPA filter inlet static pressure, HEPA filter DP Remote instrumentation - HEPA filter inlet static pressure Alarms - MDF Fan Low Static Pressure alarm at the MDF Control Panel in Room E-065 and Control Room E-RREX High Bay Exhaust Sub-system Local instrumentation - HEPA filter DP Remote instrumentation - None Alarms - High Bay Exhaust Low Static Pressure alarm at the E-Wing Alarm Panel and Control Room E-RREX Lab and Storage Exhaust Sub-system Local instrumentation - Flow velocity gages Remote instrumentation - None Alarms - Lab and Storage Exhaust Low Static Pressure alarm at the E-Wing Alarm Panel and remotely in the Control Room E-RREX Fan Room Exhaust Sub-system Local instrumentation - HEPA filter DP Remote instrumentation - None. Alarms - None. Gap Analysis Gap Number 40: Discretionary Gap - HEPA filters are not provided with ΔP instrumentation for the Lab and Storage Exhaust Sub-system. Gap Number 41: Discretionary Gap - The Fan Room Exhaust sub-system does not have any status instrumentation or alarms.	
2.2 Interlock supply and exhaust fans to prevent positive pressure differential.	[DOE Guidance Document does not provide any specific evaluation guidance discussion for this criteria]	DOE-HDBK-1169 ASHRAE Design Guide (Section 4)
	Section E supply and exhaust fans are not interlocked. If one of the RREX systems were to shut down, a secondary to tertiary confinement zone air reversal could occur. Section E would become pressurized with respect to adjacent building areas and the outside environment. Gap Analysis Gap Number 26: Discretionary Gap - Interlocks are not provided between the supply and exhaust systems.	

Evaluation Criteria	Discussion	Reference
2.3 Post accident indication of filter break-through.	Instrumentation supports post accident planning and response; should be considered critical instrumentation for SC. All four E-RREX sub-systems discharge to the SRNL Sand Filter, which is equipped with both an inlet and outlet monitoring system that reports to the SRNL control room. See FHSF Sandfilter Evaluation Criteria 2.3 for addtional detail. <u>Gap Analysis</u> No Gap.	TECH-34
2.4 Reliability of control system to maintain confinement function under normal, abnormal and accident conditions.	Address, for example, impacts of potential common mode failures from events that would require active confinement function. The E-RREX system functional classification is General Service, it is not credited in the DSA to perform a safety function. The events to be evaluated for Section E are (1) a drop/spill inside a Section E shielded cell, and (2) a low-energy process explosion inside a Section E shielded cell or laboratory, caused by an unstable lab chemical, process flammable gas or VOCs. Only the E-RREX Lab and Storage Exhaust sub-system would potentially be affected by a low-energy process explosion inside a laboratory, due to close proximity of the sub-system fans and controls on the other side of the lab module exterior wall. However, since the DSA assumes the explosion would not challenge the integrity of the lab module or the exhaust system, there is no potential common mode failure caused by this event. The E-RREX Lab and Storage Exhaust sub-system would continue to function normally. <u>Gap Analysis</u> No Gap.	DOE-HDBK-1169 (2.4)

Evaluation Criteria	Discussion	Reference
2.5 Control components should fail safe.	[DOE Guidance Document does not provide any specific evaluation guidance discussion for this criteria] The E-RREX system functional classification is General Service, it is not credited in the DSA to perform a safety function. Failure of a control component would render the associated exhaust fan inoperable, whereby the standby fan may be placed in service manually. Three of the sub-systems have a standby fan; the Fan Room Exhaust sub-system does not. However it has no automatic outlet damper and no installed instrumentation. The E-RREX High Bay Exhaust and E-RREX Lab and Storage Exhaust Sub-systems have automatic pneumatically operated outlet dampers which fail open on loss of instrument air, permitting the fan system to remain in service in case of an instrument air system failure. The E-RREX MDF Exhaust Sub-system has electrically operated inlet dampers which fail-as-is on loss of power. The system has standby power available, however. <u>Gap Analysis</u> No Gap.	DOE-HDBK-1169 (2.4)

Evaluation Criteria	Discussion	Reference
3 - Resistance to Internal Events – Fire		
3.1 Confinement ventilation systems should withstand credible fire events and be available to operate and maintain confinement.	Required for new facilities; as required by the accident analysis for existing facilities (discretionary). Must address protection of filter media.	DOE-HDBK-1169 (10.1) DOE-STD-1066
	As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Page 21 and 22 Discussion, the evaluation of internal fire events for an existing facility is only required if the accident analysis takes credit for the active confinement ventilation system.	
3.2 Confinement ventilation systems should not propagate spread of fire.	Required for new facilities; as required by the accident analysis for existing facilities (discretionary). Address fire barriers, fire dampers arrangement.	DOE-HDBK-1169 (10.1) DOE-STD-1066
	As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Page 21 and 22 Discussion, the evaluation of internal fire events for an existing facility is only required if the accident analysis takes credit for the active confinement ventilation system.	

Evaluation Criteria	Discussion	Reference
4 - Resistance to External Events – Natural Phenomena – Seismic		
4.1 Confinement ventilation systems should safely withstand earthquakes.	If the active CVS system is not credited in a seismic accident condition there is no need to evaluate that performance and/or design attribute for the confinement ventilation system (discretionary). Also, any seismic impact on the confinement ventilation system performance will be based on the current functional requirements in the DSA. NOTE: Seismic requirements may apply to Defense-in-Depth items indirectly for the protection of safety SSCs.	ASME AG-1 (AA) DOE O 420.1B DOE-HDBK-1169 (9.2)
	As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per 2004-2 Ventilation System Evaluation Guidance Addendum, March 6, 2007, Caution 4 and Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Page 22 Discussion, the evaluation of seismic events is only required if the accident analysis takes credit for the active confinement ventilation system during or after the NPH event.	

Evaluation Criteria	Discussion	Reference
5 - Resistance to External Events – Natural Phenomena – Tornado/Wind		
5.1 Confinement ventilation systems should safely withstand tornado depressurization.	If the active CVS is not credited in a tornado condition there is no need to evaluate that performance and/or design attribute for the confinement ventilation system (discretionary). Also, any tornado impact on the confinement ventilation system performance will be based on the current functional requirements in the DSA.	DOE O 420.1B DOE-HDBK-1169 (9.2)
	As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per 2004-2 Ventilation System Evaluation Guidance Addendum, March 6, 2007, Caution 4 and Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Pages 22 and 23 Discussion, the evaluation of tornado and wind events is only required if the accident analysis takes credit for the active confinement ventilation system during or after the NPH event.	
5.2 Confinement ventilation systems should withstand design wind effects on system performance.	If the active CVS is not credited in a wind condition there is no need to evaluate that performance and/or design attribute for the confinement ventilation system (discretionary). Also, any wind impact on the confinement ventilation system performance will be based on the current NP analysis in the DSA.	DOE O 420.1B DOE-HDBK-1169 (9.2)
	As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per 2004-2 Ventilation System Evaluation Guidance Addendum, March 6, 2007, Caution 4 and Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Pages 22 and 23 Discussion, the evaluation of tornado and wind events is only required if the accident analysis takes credit for the active confinement ventilation system during or after the NPH event.	

Evaluation Criteria		Discussion	Reference
		6 - Other NP Events (eg. flooding, precipitation)	
6.1	Confinement ventilation system should withstand other NP events considered credible in the DSA where the confinement ventilation system is credited.	If the active confinement ventilation system is not credited for this event there is no need to evaluate that performance and/or design attribute for the confinement ventilation system (discretionary). Also, any impact on the confinement ventilation system performance will be based on the current NP analysis in the DSA.	DOE O 420.1B DOE-HDBK-1169 (9.2)
		As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per 2004-2 Ventilation System Evaluation Guidance Addendum, March 6, 2007, Caution 4 and Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Page 23 Discussion, the evaluation of other NPH events is only required if the accident analysis takes credit for the active confinement ventilation system during or after the NPH event.	

Evaluation Criteria	Discussion	Reference
7 - Range Fires / Dust Storms		
7.1 Administrative controls should be established to protect confinement ventilation systems from barrier threatening events.	Ensure appropriately thought out response to external threat is defined (e.g. pre-fire plan).	DOE O 420.1B
	The Savannah River Forestry Department is responsible for fire fighting efforts in regards to wildland fires. They also have a program of controlled burns and mechanical thinning of underbrush to limit or prevent wildland fires spreading out of control. If the fire encroaches upon SRNL, the Savannah River Site Fire Department will direct extinguishing efforts. Building 773-A has a current Fire Pre Plan and has procedures to reduce confinement ventilation system air flow (originally develop for electrical system maintenance) that will minimize soot loading of the filters in the ventilation systems. Reference: AOP-06-007 Dust storms are not an issue at the Savannah River Site due to the regional climate. <u>Gap Analysis</u> No Gap. Administrative controls are sufficient to protect the confinement ventilation systems for barrier threatening events.	

	Evaluation Criteria	Discussion	Reference
		8 - Testability	
8.1	Design supports the periodic inspection and testing of filters and housing, and test and inspections are conducted periodically.	Ability to test for leakage per intent of N510. All E-RREX HEPA filter housings have the capability for in-place testing. In most systems, in-place test capability was added in the 1960's and testing points meet the intent of N510. For new systems, the requirements of N510 were used as the basis of design and initial testing. In-place leak testing is performed on all E-RREX HEPA filters every 18 months. HEPA Filter housings for the High Bay Exhaust use a 1950's vintage Tape-In-Place design. Housings for the MDF Exhaust and Fan Room Exhaust use Filter Housings conforming to N509, Housings for Lab and Storage Exhaust use a front load design for the 1960's. <u>Gap Analysis</u> Gap Number 42: Discretionary Gap - Tape-in-place HEPA filters do not meet the filter housing pressure boundary integrity testing requirements in N510.	DOE-HDBK-1169 (2.3.8) ASME AG-1 ASME N510
8.2	Instrumentation required to support system operability is calibrated.	Credited instrumentation should have specified calibration / surveillance requirements. Non-safety instrumentation should be calibrated as necessary to support system functionality. The E-RREX system functional classification is General Service, it is not credited in the DSA to perform a safety function. Therefore there is no credited instrumentation on any of the E-RREX sub-systems. E-RREX system non-safety instrumentation is calibrated only on an as-needed basis, there is no established calibration frequency. <u>Gap Analysis</u> No Gap.	DOE-HDBK-1169 (2.3.8)

Evaluation Criteria	Discussion	Reference
8.3 Integrated system performance testing is specified and performed.	Required responses assumed in the accident analysis must be periodically confirmed including any time constraints.	DOE-HDBK-1169 (2.3.8)
	The E-RREX system functional classification is General Service, it is not credited in the DSA to perform a safety function. Airflow direction and differential pressures are verified at key points within the building during periodic air balance testing to verify that the ventilation systems are functioning as intended. Findings are forwarded to the Design Authority Engineer. Results are documented in an Air Balance Test Report, and evaluated for any necessary corrective actions. The last full air balance test for Section E was performed in 2001. Air flow directions between rooms are also verified to support radiological surveys on a routine basis with findings forwarded to the Design Authority Engineer. <u>Gap Analysis</u> No Gap	

Evaluation Criteria	Discussion	Reference
9 - Maintenance		
9.1 Filter service life program should be established.	Filter life (shelf life, service life, total life) expectancy should be determined. Consider: filter environment, maximum delta-P, radiological loading, age, and potential chemical exposure. Per requirements of SRS Engineering Standard 15888, a Filter service life program has been established for this system. This standard is the basis of the Nuclear Air Cleaning Handbook Appendix C. The filters have a maximum shelf life of 3 years and total life of 10 years. Program is tracked using the Computerized Maintenance Management System . Gap Analysis No Gap.	DOE-HDBK-1169 (3.1 & App C)

Evaluation Criteria	Discussion	Reference
10 - Single Failure		
10.1 Failure of one component (equipment or control) shall not affect continuous operation.	Address potential failures (example failures - fan, backup power supply, switchgear). E-RREX MDF Exhaust Sub-system Normal operation is two fans running with one in standby. If one of the normally running fans fails, the standby fan is started manually. All three fans are provided with both normal and backup power. E-RREX High Bay Exhaust Sub-system Normal operation is one fan running with the other in standby. If the normally running fan fails, the standby fan may be started manually. Both fans are supplied with normal power only. E-RREX Lab and Storage Exhaust Sub-system Normal operation is one fan running with the other in standby. If the normally running fan fails, the standby fan may be started manually. Both fans are supplied with normal power only. E-RREX Fan Room Exhaust Sub-system No standby fan is provided. The system fan is supplied with normal power only. Gap Analysis Gap Number 43: Discretionary Gap - The Fan Room Exhaust sub-system does not have redundant fans.	DOE O 420.1B (Facility Safety, Chapter I, Sec. 3.b(8))

Evaluation Criteria	Discussion	Reference
10.2 Automatic backup electrical power shall be provided to all critical instruments and equipment required to operate and monitor the confinement ventilation system.	[DOE Guidance Document does not provide any specific evaluation guidance discussion for this criteria]	DOE-HDBK-1169 (2.2.7)
	<u>E-RREX MDF Exhaust Sub-system</u> All three fans and associated instrumentation are provided with automatic backup electrical power. <u>E-RREX High Bay Exhaust Sub-system</u> Both fans are supplied with normal power only. <u>E-RREX Lab and Storage Exhaust Sub-system</u> Both fans are supplied with normal power only. <u>E-RREX Fan Room Exhaust Sub-system</u> The system fan is supplied with normal power only. HVAC supply units for areas served by the High Bay Exhaust, Lab and Storage Exhaust and Fan Room Exhaust sub-systems are not supplied with backup electrical power. <u>Gap Analysis</u> Gap Number 44: Discretionary Gap - Automatic backup electrical power is not provided for the following sub-systems: High Bay Exhaust, Lab & Storage Exhaust and Fan Room Exhaust.	
10.3 Backup electrical power shall be provided to all critical instruments and equipment required to operate and monitor the confinement ventilation system.	NOTE: Safety Class is addressed through previous line.	DOE-HDBK-1169 (2.2.7)
	This evaluation criteria is NOT APPLICABLE, as it is an SS-only criteria. SRNL confinement ventilation systems are evaluated to SC criteria.	

Evaluation Criteria	Discussion	Reference
11 - Other Credited Functional Requirements		
11.1 Address any specific functional requirements for the confinement ventilation system (beyond the scope of those above) credited in the DSA.	[DOE Guidance Document does not provide any specific evaluation guidance discussion for this criteria]	10 CFR 830, Subpart B
	The E-RREX system functional classification is General Service, it is not credited in the DSA to perform a safety function. There are no functional requirements for the system credited in the DSA. <u>Gap Analysis</u> No Gap.	

Evaluation Criteria	Discussion	Reference
0 - Ventilation System Description & References		
0.1 System Description	N/A <u>System Description</u> Section E is isolated from Section B by double doors on each floor to maintain independent ventilation control. The Section E ventilation system is divided into four zones. Zone 1 is the innermost zone and includes the shielded cells and adjacent areas which have the greatest potential for radioactive contamination. Zones 2, 3, and 4 surround Zone 1 and contain offices and labs with lower potential for radioactive contamination. The Section E Heating Ventilating and Air Conditioning (HVAC) Systems provide once-through conditioned air to zones 2,3, & 4 at lower flow rates than the area exhaust systems to maintain confinement of potential contamination. Reference Attachment 11 Figure A for a system single line. Air is exhausted from Zone 1 by the Cell Exhaust (CE) systems, Regulated Room Exhaust (RREX) systems, Local Hood Exhaust (LHEX) systems, and Heating and Ventilating (HV) systems. The Zone 1 HVAC systems are designed to supply make-up air at a lower total flow than the total exhaust air flow in order to maintain a net inflow into Zone 1 from Zones 2, 3, and 4, insuring positive confinement of any contamination. Zone 2 contains offices on the Main Floor and mock-up, maintenance and utility shops on the Service Floor. There are no exhaust systems in Zone 2. The HVAC system provides excess air to Zone 2 to ensure a positive air flow into Zone 1. Zone 3 contains the service floor truck bay and cask storage areas, Radioactive Material Handling Facility Lab, and RCO lab and storage areas. Air is exhausted by an LHEX system. Excess supply air is provided to ensure a positive air flow into Zone 1. Motorized dampers are installed to isolate Zone 1 from the truck bay if either the inner or outer door is open. Zone 4 includes the Manipulator Repair Facility. There are no exhaust systems in Zone 4, although a portion of the clean room air is recycled through the HVAC units. The HVAC system provides excess air to Zone 4 to ensure a positive air flow into Zone 1. The building shell, walls and roof associated with the HVAC systems are qualified to PC-1.	N/A

Evaluation Criteria	Discussion	Reference
0.2 System References	N/A	N/A
	System Design Descriptions o M-SYD-A-00022, HVAC Supply and Miscellaneous Exhaust System Design Description o M-SYD-A-00024, IA, PLTA & Compressor Alternate CW Drawings o M-M5-A-0205, Section E HVAC Supply Air Balance Riser Diagram o M-M5-A-0206, Section E HVAC Exhaust Air Balance Riser Diagram o W167721 - HLC HVAC Flow & Control Diagram Test Procedures o TP-02-773A-EWING-01, Sec E Air Balance Test Procedure o 5Q1.2, Procedure 484, Building Air Survey o TO-05-027, 773-A D/G Annual Design Load Test Round Sheets and Other Procedures o ROD-OPS-2002-002 - Control Area Operator (CAO) Round Sheets o ROD-OPS-2002-003 - Facility Operator (FO) Round Sheets o AOP-06-007, Wildland Fire, Facility Ventilation Shutdown and/or Evacuation Standards o DuPont Engineering Specifications 3027, 3017, 5998, 7591, 8728, H16J, SH1A. o SRS Procurement Specification M-SPP-G-00243, HEPA Filter Specification o SRS Engineering Standard 15888, HEPA Filter Requirements o DOE-STD-3020-2005, DOE Technical Standard - Specification for HEPA Filters Used by DOE Contractors o DOE-STD-3025-2007, DOE Technical Standard - Quality Assurance Inspection and Testing of HEPA Filters o UL 586, UL Standard for Safety, High Efficiency, Particulate, Air Filter Units, 1996 o ANSI/ASME NQA-1, Quality Assurance Program Requirements for Nuclear Facilities Miscellaneous o Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, January 2006 o 2004-2 Ventilation System Evaluation Guidance Addendum, March 2007 o SRNL-ROE-2007-00063, SRNL Table 4-3 Submittal to DOE-SR, April 2007 o WSRC-SA-2, SRNL Technical Area (TA) Documented Safety Analysis (DSA), Revision 3 o WSRC-TS-97-00014, SRNL Technical Area (TA) Technical Safety Requirements (TSRs), Revision 4 o SRNL-ESD-2007-00017, Structural Integrity Program Scope, Resources & Estimate, February 2007	

Evaluation Criteria	Discussion	Reference
1 - Ventilation System – General Criteria		
1.1 Pressure differential should be maintained between zones and atmosphere.	Number of zones as credited by accident analysis to control hazardous material release; demonstrate by use considering potential in-leakage. The Section E zone flows and ventilation system interactions are described in the specific SDD documents. Differential pressures (DPs) are not measured directly, but are maintained between zones by monitoring and balancing air flows. Periodic monitoring is conducted, including hood face velocities (Procedure 4Q/401) and air flow directions (Procedure 5Q1.2/484). Air balances are regularly conducted on all ventilation systems within a building section to verify facility design basis flows, as documented by the Section E Air Balance. Key system parameters are recorded on a daily and weekly basis which allows monitoring of ventilation system function and performance. The HVAC Systems are designed to maintain the primary containment zones at a negative pressure with respect to surrounding areas such that a positive airflow is maintained into the primary confinement zones from the secondary confinement zones. Confinement Zones o Primary Confinement — High Level Cells / Gloveboxes / Ducting through a testable HEPA filter stage o Secondary Confinement — HLC Operating Area / Labs / Filter Room / Fan Room o Tertiary Confinement — Corridors / Offices / General Service Floor Area o Administrative Area — Offices <u>Gap Analysis</u> No Gap - DPs are properly maintained under normal conditions. Maintenance of differential pressure between building zones is not credited in the DSA for prevention or mitigation of a radiological release.	DOE-HDBK-1169 (2.2.9) ASHRAE Design Guide
1.2 Materials of construction should be appropriate for normal, abnormal and accident conditions.	[DOE Guidance Document does not provide any specific evaluation guidance discussion for this criteria] The Section E HVAC (Supply Air) systems provide clean conditioned air to the building. Ducting is fabricated from galvanized steel. Supply fans are fabricated from carbon steel. <u>Gap Analysis</u> No Gap - Materials of construction are appropriate for normal, abnormal and accident conditions.	DOE-HDBK-1169 (2.2.5) ASME AG-1
1.3 Exhaust system should withstand anticipated normal, abnormal and accident system conditions and maintain confinement integrity.	As required by accident analysis to prevent accident release. The system evaluated is a supply (not exhaust) system. See the appropriate exhaust systems for Section E (Attachments 1, 2, 4 and 5) for evaluation of this criteria. <u>Gap Analysis</u> No Gap	DOE-HDBK-1169 (2.4) ASHRAE Design Guide

Evaluation Criteria	Discussion	Reference
1.4 Confinement ventilation systems shall have appropriate filtration to minimize release.	Address: 1) Type of filter (e.g., HEPA, sand, sintered metal); 2) Filter sizing (flow capacity and pressure drop); 3) Decontamination Factor vs. accident analysis assumptions.	ASME AG-1 DOE-HDBK-1169 (2.2.1)
	The Section E HVAC (Supply Air) systems have replaceable filters, installed to filter incoming supply air. <u>Gap Analysis</u> Gap Number 33: Discretionary Gap - The manipulator shop, a secondary zone, uses re-circulated air without HEPA filtration.	

Evaluation Criteria	Discussion	Reference
2 - Ventilation System – Instrumentation & Control		
2.1 Provide system status instrumentation and/or alarms.	Address key information to ensure system operability (e.g., system delta-P, filter pressure drop). The Section E HVAC (Supply Air) systems have neither status information nor alarms provided to the Control Area Operator (CAO) in the C041 Control Room (CR). Gap Analysis Gap Number 34: Discretionary Gap - The systems do not have any remote system status instrumentation, control or alarms.	ASME AG-1 DOE-HDBK-1169 ASHRAE Design Guide (Section 4)
2.2 Interlock supply and exhaust fans to prevent positive pressure differential.	[DOE Guidance Document does not provide any specific evaluation guidance discussion for this criteria] Section E supply and exhaust fans are not interlocked. If one of the exhaust systems were to shut down, a secondary to tertiary confinement zone air reversal could occur. Section E would become pressurized with respect to adjacent building areas and the outside environment. Gap Analysis Gap Number 26: Discretionary Gap - Interlocks are not provided between the supply and exhaust systems.	DOE-HDBK-1169 ASHRAE Design Guide (Section 4)
2.3 Post accident indication of filter break-through.	Instrumentation supports post accident planning and response; should be considered critical instrumentation for SC. The Section E HVAC (Supply Air) systems are not impacted by the accident scenarios related to exhaust filter break-through. Gap Analysis No Gap - Section E HVAC systems do not have exhaust filters where breakthrough would occur.	TECH-34
2.4 Reliability of control system to maintain confinement function under normal, abnormal and accident conditions.	Address, for example, impacts of potential common mode failures from events that would require active confinement function. Not applicable. The fans are not credited in a confinement function, but serve to provide conditioned outside air to the facility. Gap Analysis No Gap	DOE-HDBK-1169 (2.4)

Evaluation Criteria	Discussion	Reference
2.5 Control components should fail safe.	[DOE Guidance Document does not provide any specific evaluation guidance discussion for this criteria] The Section E HVAC supply fans fail in a safe condition. The fans are not credited in a confinement function, but serve to provide conditioned outside air to the facility. The fan unit intake dampers shut on loss of power to prevent backflow through the fans. <u>Gap Analysis</u> No Gap	DOE-HDBK-1169 (2.4)

	Evaluation Criteria	Discussion	Reference
		3 - Resistance to Internal Events – Fire	
3.1	Confinement ventilation systems should withstand credible fire events and be available to operate and maintain confinement.	Required for new facilities; as required by the accident analysis for existing facilities (discretionary). Must address protection of filter media.	DOE-HDBK-1169 (10.1) DOE-STD-1066
		As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Page 21 and 22 Discussion, the evaluation of internal fire events for an existing facility is only required if the accident analysis takes credit for the active confinement ventilation system.	
3.2	Confinement ventilation systems should not propagate spread of fire.	Required for new facilities; as required by the accident analysis for existing facilities (discretionary). Address fire barriers, fire dampers arrangement.	DOE-HDBK-1169 (10.1) DOE-STD-1066
		As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Page 21 and 22 Discussion, the evaluation of internal fire events for an existing facility is only required if the accident analysis takes credit for the active confinement ventilation system.	

Evaluation Criteria	Discussion	Reference
4 - Resistance to External Events – Natural Phenomena – Seismic		
4.1 Confinement ventilation systems should safely withstand earthquakes.	If the active CVS system is not credited in a seismic accident condition there is no need to evaluate that performance and/or design attribute for the confinement ventilation system (discretionary). Also, any seismic impact on the confinement ventilation system performance will be based on the current functional requirements in the DSA. NOTE: Seismic requirements may apply to Defense-in-Depth items indirectly for the protection of safety SSCs.	ASME AG-1 (AA) DOE O 420.1B DOE-HDBK-1169 (9.2)
	As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per 2004-2 Ventilation System Evaluation Guidance Addendum, March 6, 2007, Caution 4 and Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Page 22 Discussion, the evaluation of seismic events is only required if the accident analysis takes credit for the active confinement ventilation system during or after the NPH event.	

	Evaluation Criteria	Discussion	Reference
		5 - Resistance to External Events – Natural Phenomena – Tornado/Wind	
5.1	Confinement ventilation systems should safely withstand tornado depressurization.	If the active CVS is not credited in a tornado condition there is no need to evaluate that performance and/or design attribute for the confinement ventilation system (discretionary). Also, any tornado impact on the confinement ventilation system performance will be based on the current functional requirements in the DSA.	DOE O 420.1B DOE-HDBK-1169 (9.2)
		As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per 2004-2 Ventilation System Evaluation Guidance Addendum, March 6, 2007, Caution 4 and Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Pages 22 and 23 Discussion, the evaluation of tornado and wind events is only required if the accident analysis takes credit for the active confinement ventilation system during or after the NPH event.	
5.2	Confinement ventilation systems should withstand design wind effects on system performance.	If the active CVS is not credited in a wind condition there is no need to evaluate that performance and/or design attribute for the confinement ventilation system (discretionary). Also, any wind impact on the confinement ventilation system performance will be based on the current NP analysis in the DSA.	DOE O 420.1B DOE-HDBK-1169 (9.2)
		As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per 2004-2 Ventilation System Evaluation Guidance Addendum, March 6, 2007, Caution 4 and Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Pages 22 and 23 Discussion, the evaluation of tornado and wind events is only required if the accident analysis takes credit for the active confinement ventilation system during or after the NPH event.	

	Evaluation Criteria	Discussion	Reference
		6 - Other NP Events (eg. flooding, precipitation)	
6.1	Confinement ventilation system should withstand other NP events considered credible in the DSA where the confinement ventilation system is credited.	If the active confinement ventilation system is not credited for this event there is no need to evaluate that performance and/or design attribute for the confinement ventilation system (discretionary). Also, any impact on the confinement ventilation system performance will be based on the current NP analysis in the DSA.	DOE O 420.1B DOE-HDBK-1169 (9.2)
		As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per 2004-2 Ventilation System Evaluation Guidance Addendum, March 6, 2007, Caution 4 and Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Page 23 Discussion, the evaluation of other NPH events is only required if the accident analysis takes credit for the active confinement ventilation system during or after the NPH event.	

	Evaluation Criteria	Discussion	Reference
		7 - Range Fires / Dust Storms	
7.1	Administrative controls should be established to protect confinement ventilation systems from barrier threatening events.	Ensure appropriately thought out response to external threat is defined (e.g. pre-fire plan).	DOE O 420.1B
		The Savannah River Forestry Department is responsible for fire fighting efforts in regards to wildland fires. They also have a program of controlled burns and mechanical thinning of underbrush to limit or prevent wildland fires spreading out of control. If the fire encroaches upon SRNL, the Savannah River Site Fire Department will direct extinguishing efforts. Building 773-A has a current Fire Pre Plan and has procedures to reduce confinement ventilation system air flow (originally develop for electrical system maintenance) that will minimize soot loading of the filters in the ventilation systems. Reference: AOP-06-007 Dust storms are not an issue at the Savannah River Site due to the regional climate. Gap Analysis No Gap. Administrative controls are sufficient to protect the confinement ventilation systems for barrier threatening events.	

	Evaluation Criteria	Discussion	Reference
		8 - Testability	
8.1	Design supports the periodic inspection and testing of filters and housing, and test and inspections are conducted periodically.	Ability to test for leakage per intent of N510.	DOE-HDBK-1169 (2.3.8) ASME AG-1 ASME N510
		Section E HVAC supply fan system filters are changed out periodically -nominally on a semi-annual basis. <u>Gap Analysis</u> No Gap - Section E HVAC systems have no testable or inspectable exhaust filters.	
8.2	Instrumentation required to support system operability is calibrated.	Credited instrumentation should have specified calibration / surveillance requirements. Non-safety instrumentation should be calibrated as necessary to support system functionality.	DOE-HDBK-1169 (2.3.8)
		The Section E HVAC (Supply Air) systems have no calibration requirements in the TSR. System non-safety instrumentation is calibrated as necessary to support system functionality: when the instrument is installed. <u>Gap Analysis</u> No Gap - Section E HVAC systems have no calibration requirements.	
8.3	Integrated system performance testing is specified and performed.	Required responses assumed in the accident analysis must be periodically confirmed including any time constraints.	DOE-HDBK-1169 (2.3.8)
		The E-HVAC system functional classification is General Service, it is not credited in the DSA to perform a safety function. Airflow direction and differential pressures are verified at key points within the building during periodic air balance testing to verify that the ventilation systems are functioning as intended. Findings are forwarded to the Design Authority Engineer. Results are documented in an Air Balance Test Report, and evaluated for any necessary corrective actions. The last full air balance test for Section E was performed in 2001. Air flow directions between rooms are also verified to support radiological surveys on a routine basis with findings forwarded to the Design Authority Engineer.. <u>Gap Analysis</u> No Gap	

Evaluation Criteria	Discussion	Reference
	9 - Maintenance	
9.1 Filter service life program should be established.	Filter life (shelf life, service life, total life) expectancy should be determined. Consider: filter environment, maximum delta-P, radiological loading, age, and potential chemical exposure. Sections E HVAC units do not use HEPA filters. A service life program is not required. Gap Analysis No Gap - Section E HVAC systems do not use HEPA filters.	DOE-HDBK-1169 (3.1 & App C)

Evaluation Criteria	Discussion	Reference
	10 - Single Failure	
10.1 Failure of one component (equipment or control) shall not affect continuous operation.	Address potential failures (example failures - fan, backup power supply, switchgear). The Section E HVAC (Supply Air) systems have no installed standby components. Procedures are established and in place to identify equipment failures and to implement mitigating actions. No single failure in the Section E HVAC system will prevent critical confinement equipment from operating. Also, failure of an individual supply unit will not cause a differential pressure inversion between any of the confinement zones. <u>Gap Analysis</u> No Gap.	DOE O 420.1B (Facility Safety, Chapter I, Sec. 3.b(8))
10.2 Automatic backup electrical power shall be provided to all critical instruments and equipment required to operate and monitor the confinement ventilation system.	[DOE Guidance Document does not provide any specific evaluation guidance discussion for this criteria] The Section E HVAC (Supply Air) systems will not operate in the event of a power failure. <u>Gap Analysis</u> No Gap - Operation of the HVAC supply units is not necessary to maintain confinement during a loss of power.	DOE-HDBK-1169 (2.2.7)
10.3 Backup electrical power shall be provided to all critical instruments and equipment required to operate and monitor the confinement ventilation system.	NOTE: Safety Class is addressed through previous line. This evaluation criteria is NOT APPLICABLE, as it is an SS-only criteria. SRNL confinement ventilation systems are evaluated to SC criteria.	DOE-HDBK-1169 (2.2.7)

Evaluation Criteria	Discussion	Reference
11 - Other Credited Functional Requirements		
11.1 Address any specific functional requirements for the confinement ventilation system (beyond the scope of those above) credited in the DSA.	[DOE Guidance Document does not provide any specific evaluation guidance discussion for this criteria] None Gap Analysis No Gap	10 CFR 830, Subpart B

Evaluation Criteria	Discussion	Reference
0 - Ventilation System Description & References		
0.1 System Description	N/A <u>System Description</u> The Section E Local Hood Exhaust (E-LHEX) System consists of two independent sub-systems that exhaust areas in the Section E secondary confinement zone. Both E-LHEX sub-systems discharge to the SRNL Sand Filter system via branch ducts that connect to the sand filter inlet duct on the Section E roof. Reference Attachment 11 Figure A for a system single line. <u>E-LHEX High Bay Exhaust Sub-system</u> Two (2) E-LHEX Fans exhaust the High Bay Loading Area (Room E-079), using single-stage HEPA filtration, with one filter at each of the two fan inlets. Normal operation is one fan running with the other in standby. Both fans are supplied with normal power only. If the normally running fan fails, alarms activate locally in the Section E cell operating area and remotely in the C041 Control Room. Note - the High Bay Loading Area is also exhausted by the E-RREX system, which is covered in a separate Table 5-1. <u>E-LHEX Hood Exhaust Sub-system</u> E-LHEX Fan E14 (EP-5916) exhausts the fume hood in Room E-075, in the Cell Block A loading area, using single-stage HEPA filtration with one filter at the fan inlet. If the fan fails, alarms are activated in the Section E operating area and in the C041 Control Room. The building shell, walls and roof associated with the LHEX systems are qualified to PC-1.	N/A

Evaluation Criteria	Discussion	Reference
0.2 System References	N/A	N/A
	System Design Descriptions o M-SYD-A-00022, 773-A Section E, HVAC Supply and Miscellaneous Exhaust o G-SYD-A-00002, SRNL Sand Filter System Design Description o M-SYD-A-00024, IA, PLTA & Compressor Alternate CW Drawings o M-M5-A-0206, Section E Exhaust Systems Air Balance Riser Diagram o W144392, Basic Design Manual Section E H&V Flow Diagram o P-PH-A-0076, High Level Caves Supply and Exhaust Systems Air Flow and Balance o W157496, Heating and Ventilating, Section E High Level Caves Main Floor Plan Test Procedures o TP-02-773A-EWING-01, Section E Air Balance Test Procedure o 5Q1.2, Procedure 484, Building Air Survey o TO-05-027, 773-A D/G Annual Design Load Test Round Sheets and Other Procedures o ROD-OPS-2002-002 - Control Area Operator (CAO) Round Sheets o ROD-OPS-2002-003 - Facility Operator (FO) Round Sheets o AOP-06-007, Wildland Fire, Facility Ventilation Shutdown and/or Evacuation Standards o DuPont Engineering Specifications 3027, 3017, 5998, 7591, 8728, H16J, SH1A. o SRS Procurement Specification M-SPP-G-00243, HEPA Filter Specification o SRS Engineering Standard 15888, HEPA Filter Requirements o DOE-STD-3020-2005, DOE Technical Standard - Specification for HEPA Filters Used by DOE Contractors o DOE-STD-3025-2007, DOE Technical Standard - Quality Assurance Inspection and Testing of HEPA Filters o UL 586, UL Standard for Safety, High Efficiency, Particulate, Air Filter Units, 1996 o ANSI/ASME NQA-1, Quality Assurance Program Requirements for Nuclear Facilities Miscellaneous o Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, January 2006 o 2004-2 Ventilation System Evaluation Guidance Addendum, March 2007 o SRNL-ROE-2007-00063, SRNL Table 4-3 Submittal to DOE-SR, April 2007 o WSRC-SA-2, SRNL Technical Area (TA) Documented Safety Analysis (DSA), Revision 3 o WSRC-TS-97-00014, SRNL Technical Area (TA) Technical Safety Requirements (TSRs), Revision 4 o SRNL-ESD-2007-00017, Structural Integrity Program Scope, Resources & Estimate, February 2007	

Evaluation Criteria	Discussion	Reference
1 - Ventilation System – General Criteria		
1.1 Pressure differential should be maintained between zones and atmosphere.	Number of zones as credited by accident analysis to control hazardous material release; demonstrate by use considering potential in-leakage.	DOE-HDBK-1169 (2.2.9) ASHRAE Design Guide
	Confinement Zones o Primary Confinement — Shielded Cells / Gloveboxes / Ducting through 1st testable HEPA filter stage o Secondary Confinement — Cell Operating & Service Areas / Cell roof / HEPA filter room / Fan Room o Tertiary Confinement — Corridors / Offices / General Service Floor Area See Table 5-1 for the Cell Exhaust System for a discussion of the Section E primary confinement zones. The E-LHEX exhaust systems serve secondary confinement zones only. Secondary confinement zones consist of the cell large equipment loading area (high bay), cell small equipment loading areas, manipulator glovebox room, offices, change/restrooms and cell operating areas. These areas have a limited quantity of direct supply air; the major portion is drawn from the tertiary confinement zone. These areas have a number of direct exhaust systems for locations with a higher contamination potential. Tertiary confinement zones consist of office, storage, maintenance and support spaces surrounding the secondary confinement zone. The spaces have a mixture of recirculating HVAC systems, 100% outside air HVAC systems and unfiltered exhaust systems. Differential pressures between zones are not measured directly, but instead are maintained by periodic monitoring of air flow, and by periodic performance of air flow balance tests. Air flow direction checks are performed quarterly per Manual 5Q1.2 - 484. Air balance tests are performed periodically to ensure proper air flows and room differential pressures. The last such test for Section E was performed in 2001. <u>Gap Analysis</u> No Gap.	
1.2 Materials of construction should be appropriate for normal, abnormal and accident conditions.	[DOE Guidance Document does not provide any specific evaluation guidance discussion for this criteria]	DOE-HDBK-1169 (2.2.5) ASME AG-1
	All ductwork is either 16 or 22 gauge galvanized carbon steel. Where flanged joints are used, they are sealed with neoprene gaskets. All fans are carbon steel with protective coating, with flexible connections at the fan inlet and outlet. HEPA filter housings are stainless steel. <u>Gap Analysis</u> No Gap. Materials of construction are appropriate for normal, abnormal and accident conditions.	

Evaluation Criteria	Discussion	Reference
1.3 Exhaust system should withstand anticipated normal, abnormal and accident system conditions and maintain confinement integrity.	As required by accident analysis to prevent accident release. The E-LHEX system functional classification is General Services, it is not credited in the DSA to perform a safety function. The events to be evaluated for Section E are (1) a drop/spill inside a Section E shielded cell, and (2) a low-energy process explosion inside a Section E shielded cell or laboratory, caused by an unstable lab chemical, flammable gas or VOCs. Since neither of the E-LHEX sub-systems serves these particular areas, the E-LHEX system HEPA filters are not vulnerable to damage from the above events. <u>Gap Analysis</u> No Gap.	DOE-HDBK-1169 (2.4) ASHRAE Design Guide

Evaluation Criteria	Discussion	Reference
1.4 Confinement ventilation systems shall have appropriate filtration to minimize release.	Address: 1) Type of filter (e.g., HEPA, sand, sintered metal); 2) Filter sizing (flow capacity and pressure drop); 3) Decontamination Factor vs. accident analysis assumptions.	ASME AG-1 DOE-HDBK-1169 (2.2.1)
	Nuclear Grade HEPA filters are procured to SRS Specification M-SPP-G-00243 which incorporates the requirements of ASME AG-1. Each E-LHEX exhaust sub-system utilizes single stage HEPA filters periodically leak tested in place to confirm a filter housing filtration efficiency of 99.95%. Prior to receipt the filters are tested at the Independent Filter Testing Facility (FTF) to confirm an efficiency of at least 99.97% for a decontamination factor DF = 3333. Decontamination factor has not been considered in the facility DSA. The measured air flows for the E-RREX sub-systems are compared to the HEPA filters nominal sizes and capacity ratings specified by ASME AG-1, Section FC: Hood Exhaust- size and rating: 24"x24"x11.5", 1000 CFM max. measured flow branch- 740 CFM High Bay Exh.- size and rating: 24"x30"x5.88", 500 CFM measured flow - 717 CFM The High Bay Exhaust sub-system exceeds the nominal capacity ratings. The air is discharged to the sand filter before it is released to the environment. Per DOE-HNBK-1169, Section 3.3.6.1, "Normal in-service pressures should be limited to 3 to 5 in.wc above startup pressure". The HEPA filters are not operated outside this guideline; filters are changed if a 5" differential pressure is encountered. The E-LHEX sub-systems are equipped with pneumatically controlled static pressure compensation systems to maintain a constant air flow as the pre-filter and HEPA filter pressure drop increases over time due to filter loading. The High Bay Exhaust sub-system uses 1950's style "tape-in-place" configured HEPA filter mounting assemblies in lieu of enclosed filter housings. Tape forms a part of the confinement barrier and the wooden filter case is exposed to local hazards including fire . This style housing is highly dependent upon the skill of the worker to properly install and seal the HEPA filter. Gap Analysis Gap Number 35: Discretionary Gap - High Bay Exhaust Sub-System airflow exceeds HEPA filter rated capacity.	

Evaluation Criteria	Discussion	Reference
2 - Ventilation System – Instrumentation & Control		
2.1 Provide system status instrumentation and/or alarms.	Address key information to ensure system operability (e.g., system delta-P, filter pressure drop).	ASME AG-1 DOE-HDBK-1169 ASHRAE Design Guide (Section 4)
	<u>E-LHEX High Bay Exhaust Sub-system</u> Local instrumentation - HEPA filter DP indicator Remote instrumentation - None Alarms - Room E-079 Low Static Pressure alarms locally at the E-Wing Alarm Panel and remotely in the Control Room <u>E-LHEX Hood Exhaust Sub-system</u> Local instrumentation - Flow velocity gage at fan inlet / HEPA filter DP indicator Remote instrumentation - None Alarms - E075 LHEX Low Static Pressure alarm locally at the E-Wing Alarm Panel and remotely in the Control Room <u>Gap Analysis</u> No Gap.	
2.2 Interlock supply and exhaust fans to prevent positive pressure differential.	[DOE Guidance Document does not provide any specific evaluation guidance discussion for this criteria]	DOE-HDBK-1169 ASHRAE Design Guide (Section 4)
	Section E supply and exhaust fans are not interlocked. If one of the LHEX systems were to shut down, a secondary to tertiary confinement zone air reversal could occur. Section E would become pressurized with respect to adjacent building areas and the outside environment. <u>Gap Analysis</u> Gap Number 26: Discretionary Gap - Interlocks are not provided between the supply and exhaust systems.	
2.3 Post accident indication of filter break-through.	Instrumentation supports post accident planning and response; should be considered critical instrumentation for SC.	TECH-34
	These system then discharges to the SRNL Sand Filter which is equipped with both an inlet and outlet monitoring system which reports to the SRNL control room. See attachment 9 Evaluation Criteria 2.3 for addtional detail.. <u>Gap Analysis</u> No Gap.	

Evaluation Criteria	Discussion	Reference
2.4 Reliability of control system to maintain confinement function under normal, abnormal and accident conditions.	Address, for example, impacts of potential common mode failures from events that would require active confinement function.	DOE-HDBK-1169 (2.4)
	The E-LHEX system functional classification is General Services, it is not credited in the DSA to perform a safety function. The events to be evaluated for Section E are (1) a drop/spill inside a Section E shielded cell, and (2) a low-energy process explosion inside a Section E shielded cell or laboratory, caused by an unstable lab chemical, flammable gas or VOCs. Since neither of the E-LHEX sub-systems serves these particular areas, the E-LHEX system would not be affected by a low-energy process explosion inside a laboratory, since the DSA assumes the explosion would not challenge the integrity of the lab module. Therefore there is no potential common mode failure caused by this event. The E-LHEX sub-systems would continue to function normally. Gap Analysis No Gap.	
2.5 Control components should fail safe.	[DOE Guidance Document does not provide any specific evaluation guidance discussion for this criteria]	DOE-HDBK-1169 (2.4)
	The E-LHEX system functional classification is General Service. It is not credited in the DSA to perform a safety function. Failure of a control component would render the associated hood exhaust fan inoperable, whereby for the High Bay Exhaust fan, the standby fan may be placed in service manually. The hood exhaust fan has no standby fan. In case of fan failure an alarm is sounded in the main control room and all activities in the hood are stopped. Both sub-systems have automatic pneumatically operated outlet dampers which fail open on loss of instrument air, permitting the fan system to remain in service in case of an instrument air system failure. Gap Analysis No Gap.	

Evaluation Criteria	Discussion	Reference
3 - Resistance to Internal Events – Fire		
3.1 Confinement ventilation systems should withstand credible fire events and be available to operate and maintain confinement.	Required for new facilities; as required by the accident analysis for existing facilities (discretionary). Must address protection of filter media.	DOE-HDBK-1169 (10.1) DOE-STD-1066
	As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Page 21 and 22 Discussion, the evaluation of internal fire events for an existing facility is only required if the accident analysis takes credit for the active confinement ventilation system.	
3.2 Confinement ventilation systems should not propagate spread of fire.	Required for new facilities; as required by the accident analysis for existing facilities (discretionary). Address fire barriers, fire dampers arrangement.	DOE-HDBK-1169 (10.1) DOE-STD-1066
	As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Page 21 and 22 Discussion, the evaluation of internal fire events for an existing facility is only required if the accident analysis takes credit for the active confinement ventilation system.	

Evaluation Criteria	Discussion	Reference
4 - Resistance to External Events – Natural Phenomena – Seismic		
4.1 Confinement ventilation systems should safely withstand earthquakes.	If the active CVS system is not credited in a seismic accident condition there is no need to evaluate that performance and/or design attribute for the confinement ventilation system (discretionary). Also, any seismic impact on the confinement ventilation system performance will be based on the current functional requirements in the DSA. NOTE: Seismic requirements may apply to Defense-in-Depth items indirectly for the protection of safety SSCs.	ASME AG-1 (AA) DOE O 420.1B DOE-HDBK-1169 (9.2)
	As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per 2004-2 Ventilation System Evaluation Guidance Addendum, March 6, 2007, Caution 4 and Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Page 22 Discussion, the evaluation of seismic events is only required if the accident analysis takes credit for the active confinement ventilation system during or after the NPH event.	

	Evaluation Criteria	Discussion	Reference
		5 - Resistance to External Events – Natural Phenomena – Tornado/Wind	
5.1	Confinement ventilation systems should safely withstand tornado depressurization.	If the active CVS is not credited in a tornado condition there is no need to evaluate that performance and/or design attribute for the confinement ventilation system (discretionary). Also, any tornado impact on the confinement ventilation system performance will be based on the current functional requirements in the DSA. As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per 2004-2 Ventilation System Evaluation Guidance Addendum, March 6, 2007, Caution 4 and Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Pages 22 and 23 Discussion, the evaluation of tornado and wind events is only required if the accident analysis takes credit for the active confinement ventilation system during or after the NPH event.	DOE O 420.1B DOE-HDBK-1169 (9.2)
5.2	Confinement ventilation systems should withstand design wind effects on system performance.	If the active CVS is not credited in a wind condition there is no need to evaluate that performance and/or design attribute for the confinement ventilation system (discretionary). Also, any wind impact on the confinement ventilation system performance will be based on the current NP analysis in the DSA. As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per 2004-2 Ventilation System Evaluation Guidance Addendum, March 6, 2007, Caution 4 and Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Pages 22 and 23 Discussion, the evaluation of tornado and wind events is only required if the accident analysis takes credit for the active confinement ventilation system during or after the NPH event.	DOE O 420.1B DOE-HDBK-1169 (9.2)

	Evaluation Criteria	Discussion	Reference
		6 - Other NP Events (eg. flooding, precipitation)	
6.1	Confinement ventilation system should withstand other NP events considered credible in the DSA where the confinement ventilation system is credited.	If the active confinement ventilation system is not credited for this event there is no need to evaluate that performance and/or design attribute for the confinement ventilation system (discretionary). Also, any impact on the confinement ventilation system performance will be based on the current NP analysis in the DSA.	DOE O 420.1B DOE-HDBK-1169 (9.2)
		As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per 2004-2 Ventilation System Evaluation Guidance Addendum, March 6, 2007, Caution 4 and Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Page 23 Discussion, the evaluation of other NPH events is only required if the accident analysis takes credit for the active confinement ventilation system during or after the NPH event.	

	Evaluation Criteria	Discussion	Reference
		7 - Range Fires / Dust Storms	
7.1	Administrative controls should be established to protect confinement ventilation systems from barrier threatening events.	Ensure appropriately thought out response to external threat is defined (e.g. pre-fire plan).	DOE O 420.1B
		The Savannah River Forestry Department is responsible for fire fighting efforts in regards to wildland fires. They also have a program of controlled burns and mechanical thinning of underbrush to limit or prevent wildland fires spreading out of control. If the fire encroaches upon SRNL, the Savannah River Site Fire Department will direct extinguishing efforts. Building 773-A has a current Fire Pre Plan and has procedures to reduce confinement ventilation system air flow (originally develop for electrical system maintenance) that will minimize soot loading of the filters in the ventilation systems. Reference: AOP-06-007 Dust storms are not an issue at the Savannah River Site due to the regional climate. <u>Gap Analysis</u> No Gap. Administrative controls are sufficient to protect the confinement ventilation systems for barrier threatening events.	

Evaluation Criteria	Discussion	Reference
8 - Testability		
8.1 Design supports the periodic inspection and testing of filters and housing, and test and inspections are conducted periodically.	Ability to test for leakage per intent of N510.	DOE-HDBK-1169 (2.3.8) ASME AG-1 ASME N510
	All E-LHEX HEPA filter housings have the capability for in-place testing. This in-place test capability was added in the 1960's and testing points meet the intent of N510. Aerosol efficiency testing is performed on all E-LHEX HEPA filters every 18 months. The E-LHEX uses 1950's style "tape-in-place" configured HEPA filter mounting assemblies in lieu of enclosed filter housings. Tape forms a part of the confinement barrier and the wooden filter case is exposed to local hazards including fire . This style housing is highly dependent upon the skill of the worker to properly install and seal the HEPA filter. <u>Gap Analysis</u> Gap Number 36: Discretionary Gap - Tape-in-place HEPA filters do not meet the filter housing pressure boundary integrity testing requirements in N510.	
8.2 Instrumentation required to support system operability is calibrated.	Credited instrumentation should have specified calibration / surveillance requirements. Non-safety instrumentation should be calibrated as necessary to support system functionality.	DOE-HDBK-1169 (2.3.8)
	The E-LHEX system functional classification is General Service, it is not credited in the DSA to perform a safety function. Therefore there is no credited instrumentation on any of the E-LHEX sub-systems. E-LHEX system non-safety instrumentation is calibrated only on an as-needed basis, there is no established calibration frequency. <u>Gap Analysis</u> No Gap.	

Evaluation Criteria	Discussion	Reference
8.3 Integrated system performance testing is specified and performed.	Required responses assumed in the accident analysis must be periodically confirmed including any time constraints. The E-LHEX system functional classification is General Service, it is not credited in the DSA to perform a safety function. Airflow direction and differential pressures are verified at key points within the building during periodic air balance testing to verify that the ventilation systems are functioning as intended. Findings are forwarded to the Design Authority Engineer. Results are documented in an Air Balance Test Report, and evaluated for any necessary corrective actions. The last full air balance test for Section E was performed in 2001. Air flow directions between rooms are also verified to support radiological surveys on a routine basis with findings forwarded to the Design Authority Engineer. <u>Gap Analysis</u> No Gap	DOE-HDBK-1169 (2.3.8)

Evaluation Criteria	Discussion	Reference
9 - Maintenance		
9.1 Filter service life program should be established.	Filter life (shelf life, service life, total life) expectancy should be determined. Consider: filter environment, maximum delta-P, radiological loading, age, and potential chemical exposure.	DOE-HDBK-1169 (3.1 & App C)
	Per requirements of SRS Engineering Standard 15888, a Filter service life program has been established for this system. This standard is the basis of the Nuclear Air Cleaning Handbook Appendix C. The filters have a maximum shelf life of 3 years and total life of 10 years. Program is tracked using the Computerized Maintenance Management System . <u>Gap Analysis</u> No Gap.	

Evaluation Criteria	Discussion	Reference
10 - Single Failure		
10.1 Failure of one component (equipment or control) shall not affect continuous operation.	Address potential failures (example failures - fan, backup power supply, switchgear).	DOE O 420.1B (Facility Safety, Chapter I, Sec. 3.b(8))
	E-LHEX High Bay Exhaust Sub-system Normal operation is one fan running with the other in standby. If the normally running fan fails, the standby fan may be started manually. Both fans are supplied with normal power only. E-LHEX Hood Exhaust Sub-system No standby fan is provided. The system fan is supplied with normal power only. Gap Analysis Gap Number 37: Discretionary Gap - The Hood Exhaust sub-system does not have redundant fans.	
10.2 Automatic backup electrical power shall be provided to all critical instruments and equipment required to operate and monitor the confinement ventilation system.	[DOE Guidance Document does not provide any specific evaluation guidance discussion for this criteria]	DOE-HDBK-1169 (2.2.7)
	E-LHEX High Bay Exhaust Sub-system Both fans are supplied with normal power only. E-LHEX Hood Exhaust Sub-system The system fan is supplied with normal power only. HVAC supply units for areas served by the High Bay Exhaust and Hood Exhaust sub-systems are not supplied with backup electrical power. Gap Analysis Gap Number 38: Discretionary Gap - Automatic backup electrical power is not provided for the following E-LHEX sub-systems: High Bay Exhaust and Hood Exhaust.	

Evaluation Criteria	Discussion	Reference
10.3 Backup electrical power shall be provided to all critical instruments and equipment required to operate and monitor the confinement ventilation system.	NOTE: Safety Class is addressed through previous line.	DOE-HDBK-1169 (2.2.7)
	This evaluation criteria is NOT APPLICABLE, as it is an SS-only criteria. SRNL confinement ventilation systems are evaluated to SC criteria.	

Evaluation Criteria	Discussion	Reference
11 - Other Credited Functional Requirements		
11.1 Address any specific functional requirements for the confinement ventilation system (beyond the scope of those above) credited in the DSA.	[DOE Guidance Document does not provide any specific evaluation guidance discussion for this criteria] The E-LHEX system functional classification is General Service, it is not credited in the DSA to perform a safety function. There are no functional requirements for the system credited in the DSA. Gap Analysis No Gap.	10 CFR 830, Subpart B

Evaluation Criteria	Discussion	Reference
0 - Ventilation System Description & References		
0.1 System Description	N/A <u>System Description</u> The Section E Heating and Ventilating (E-HV) System consists of two independent low volume sub-systems that exhaust two rooms in the Section E tertiary confinement zone. Both E-HV sub-systems discharge to atmosphere above the Section E roof. Reference Attachment 11 Figure A for a system single line. <u>E-HV Men's Change Room Exhaust Sub-system</u> One E-HV Fan exhausts the Men's Change Room (Room E-035) using single-stage HEPA filtration. The fan is supplied with normal power only, and there is no standby fan. There is no system instrumentation or alarms. <u>E-HV Women's Change Room Exhaust Sub-system</u> One E-HV Fan exhausts the Women's Change Room (Room E-027) using no filtration. The fan is supplied with normal power only, and there is no standby fan. There is no system instrumentation or alarms. The building shell, walls and roof associated with the HV systems are qualified to PC-1.	N/A

Evaluation Criteria	Discussion	Reference
0.2 System References	N/A <u>System Design Descriptions</u> o M-SYD-A-00022, 773-A Section E, HVAC Supply and Miscellaneous Exhaust <u>Drawings</u> o M-M5-A-0206, Section E Exhaust Systems Air Balance Riser Diagram o W144392, Basic Design Manual Section E H&V Flow Diagram o P-PH-A-0076, High Level Caves Supply and Exhaust Systems Air Flow and Balance o W157496, Heating and Ventilating, Section E High Level Caves Main Floor Plan o M-M5-A-0116, Section E Partial Roof and Service Floor Plans o M-M5-A-0120, Section E Partial Main Floor, Service Floor and Roof Plans, HV & HVAC System <u>Test Procedures</u> o TP-02-773A-EWING-01, Section E Air Balance Test Procedure o 5Q1.2, Procedure 484, Building Air Survey o TO-05-027, 773-A D/G Annual Design Load Test <u>Round Sheets and Other Procedures</u> o ROD-OPS-2002-002 - Control Area Operator (CAO) Round Sheets o ROD-OPS-2002-003 - Facility Operator (FO) Round Sheets o AOP-06-007, Wildland Fire, Facility Ventilation Shutdown and/or Evacuation <u>Standards</u> o DuPont Engineering Specifications 3027, 3017, 5998, 7591, 8728, H16J, SH1A. o SRS Procurement Specification M-SPP-G-00243, HEPA Filter Specification o SRS Engineering Standard 15888, HEPA Filter Requirements o DOE-STD-3020-2005, DOE Technical Standard - Specification for HEPA Filters Used by DOE Contractors o DOE-STD-3025-2007, DOE Technical Standard - Quality Assurance Inspection and Testing of HEPA Filters o UL 586, UL Standard for Safety, High Efficiency, Particulate, Air Filter Units, 1996 o ANSI/ASME NQA-1, Quality Assurance Program Requirements for Nuclear Facilities <u>Miscellaneous</u> o Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, January 2006 o 2004-2 Ventilation System Evaluation Guidance Addendum, March 2007 o SRNL-ROE-2007-00063, SRNL Table 4-3 Submittal to DOE-SR, April 2007 o WSRC-SA-2, SRNL Technical Area (TA) Documented Safety Analysis (DSA), Revision 3 o WSRC-TS-97-00014, SRNL Technical Area (TA) Technical Safety Requirements (TSRs), Revision 4 o SRNL-ESD-2007-00017, Structural Integrity Program Scope, Resources & Estimate, February 2007	N/A

Evaluation Criteria	Discussion	Reference
1 - Ventilation System – General Criteria		
1.1 Pressure differential should be maintained between zones and atmosphere.	Number of zones as credited by accident analysis to control hazardous material release; demonstrate by use considering potential in-leakage. Confinement Zones o Primary Confinement — Shielded Cells / Gloveboxes / Ducting through 1st testable HEPA filter stage o Secondary Confinement — Cell Operating & Service Areas / Cell roof / HEPA filter room / Fan Room o Tertiary Confinement — Corridors / Offices / General Service Floor Area See Table 5-1 for the Cell Exhaust System for a discussion of the Section E primary confinement zones. The E-HV exhaust systems serve tertiary confinement zones only. Secondary confinement zones consist of the cell large equipment loading area (high bay), cell small equipment loading areas, manipulator glovebox room, offices, change/restrooms and cell operating areas. These areas have a limited quantity of direct supply air; the major portion is drawn from the tertiary confinement zone. These areas have a number of direct exhaust systems for locations with a higher contamination potential. Tertiary confinement zones consist of office, storage, maintenance and support spaces surrounding the secondary confinement zone. The spaces have a mixture of recirculating HVAC systems, 100% outside air HVAC systems and unfiltered exhaust systems. Differential pressures between zones are not measured directly, but instead are maintained by periodic monitoring of air flow, and by periodic performance of air flow balance tests. Air flow direction checks are performed quarterly per Manual 5Q1.2 - 484. Air balance tests are performed periodically to ensure proper air flows and room differential pressures. The last such test for Section E was performed in 2001. <u>Gap Analysis</u> No Gap	DOE-HDBK-1169 (2.2.9) ASHRAE Design Guide
1.2 Materials of construction should be appropriate for normal, abnormal and accident conditions.	[DOE Guidance Document does not provide any specific evaluation guidance discussion for this criteria] All ductwork is either 16 or 22 gauge galvanized carbon steel. Where flanged joints are used, they are sealed with neoprene gaskets. All fans are carbon steel with protective coating, with flexible connections at the fan inlet and outlet. <u>Gap Analysis</u> No Gap. Materials of construction are appropriate for normal, abnormal and accident conditions.	DOE-HDBK-1169 (2.2.5) ASME AG-1

Evaluation Criteria	Discussion	Reference
1.3 Exhaust system should withstand anticipated normal, abnormal and accident system conditions and maintain confinement integrity.	As required by accident analysis to prevent accident release.	DOE-HDBK-1169 (2.4) ASHRAE Design Guide
	The E-HV system functional classification is General Service; it is not credited in the DSA to perform a safety function. None of the events (accidents) evaluated by this report are applicable to the men's & women's change rooms. Airborne contamination from spills and low energy explosions could reach these systems. A gap has been identified in Evaluation Criteria 1.4 Gap Analysis No Gap - See Evaluation Criteria 1.4 for Discretionary Gap.	
1.4 Confinement ventilation systems shall have appropriate filtration to minimize release.	Address: 1) Type of filter (e.g., HEPA, sand, sintered metal); 2) Filter sizing (flow capacity and pressure drop); 3) Decontamination Factor vs. accident analysis assumptions.	ASME AG-1 DOE-HDBK-1169 (2.2.1)
	The E-HV Men's Change Room Exhaust sub-system utilizes single stage HEPA filtration in an arrangement such that the HEPA filter design flow and pressure drop do not exceed the normal rated capacity as established in ASME AG-1, Section FC (square filters). Nuclear Grade HEPA filters are procured to SRS Specification M-SPP-G-00243 which incorporates the requirements of ASME AG-1. In-place testing is performed to ensure a filter housing efficiency of at least 99.95%. Prior to receipt the filters are tested at the Independent Filter Testing Facility (FTF) to confirm an efficiency of at least 99.97% for a decontamination factor DF = 3333. Decontamination factor has not been considered in the facility DSA. The E-HV Women's Change Room Exhaust sub-system is not filtered. Gap Analysis Gap Number 28: Discretionary Gap - The Women's Change Room Exhaust sub-system exhaust does not have HEPA filtration before being released to the environment.	

Evaluation Criteria	Discussion	Reference
2 - Ventilation System – Instrumentation & Control		
2.1 Provide system status instrumentation and/or alarms.	Address key information to ensure system operability (e.g., system delta-P, filter pressure drop).	ASME AG-1 DOE-HDBK-1169 ASHRAE Design Guide (Section 4)
	E-HV Men's Change Room Exhaust Sub-system Local instrumentation - None. Remote instrumentation - None. Alarms - None. E-HV Women's Change Room Exhaust Sub-system Local instrumentation - None. Remote instrumentation - None. Alarms - None Gap Analysis Gap Number 29: Discretionary Gap - The two sub-systems do not have any local or remote system status instrumentation or alarms.	
2.2 Interlock supply and exhaust fans to prevent positive pressure differential.	[DOE Guidance Document does not provide any specific evaluation guidance discussion for this criteria]	DOE-HDBK-1169 ASHRAE Design Guide (Section 4)
	Section E supply and exhaust fans are not interlocked. If one of the HV systems were to shut down, a tertiary confiement zone to atmosphere would not occur due to small capacity (~ 500 CFM) compared to the total cascaded airflow from tertiary to secondary confinement zone. Gap Analysis No Gap	
2.3 Post accident indication of filter break-through.	Instrumentation supports post accident planning and response; should be considered critical instrumentation for SC.	TECH-34
	The E-HV system functional classification is General Services, it is not credited in the DSA to perform a safety function. The E-HV Men's Change Room Exhaust sub-system, after HEPA filtration, discharges directly to the atmosphere at roof top level. The E-HV Women's Change Room Exhaust sub-system, which is not filtered, discharges directly to the atmosphere at roof top level. Gap Analysis Gap Number 30: Discretionary Gap - Emission points from tertiary confinement zone do not have post accident indication of filter break through.	

	Evaluation Criteria	Discussion	Reference
2.4	Reliability of control system to maintain confinement function under normal, abnormal and accident conditions.	Address, for example, impacts of potential common mode failures from events that would require active confinement function. The E-HV system functional classification is General Service, it is not credited in the DSA to perform a safety function. The events to be evaluated for Section E are (1) a drop/spill inside a Section E shielded cell, and (2) a low-energy process explosion inside a Section E shielded cell or laboratory, caused by an unstable lab chemical, process flammable gas or VOCs. Since neither of the E-HV sub-systems serves these particular areas, the E-HV system would not be affected by a low-energy process explosion inside a laboratory, since the DSA assumes the explosion would not challenge the integrity of the lab module. Therefore there is no potential common mode failure caused by this event. The E-HV sub-systems would continue to function normally. <u>Gap Analysis</u> No Gap.	DOE-HDBK-1169 (2.4)
2.5	Control components should fail safe.	[DOE Guidance Document does not provide any specific evaluation guidance discussion for this criteria] Neither of the E-HV sub-systems have any automatic control components. If any control components are added to correct other gaps, they will be fail safe. <u>Gap Analysis</u> No Gap.	DOE-HDBK-1169 (2.4)

Evaluation Criteria	Discussion	Reference
3 - Resistance to Internal Events – Fire		
3.1 Confinement ventilation systems should withstand credible fire events and be available to operate and maintain confinement.	Required for new facilities; as required by the accident analysis for existing facilities (discretionary). Must address protection of filter media.	DOE-HDBK-1169 (10.1) DOE-STD-1066
	As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Page 21 and 22 Discussion, the evaluation of internal fire events for an existing facility is only required if the accident analysis takes credit for the active confinement ventilation system.	
3.2 Confinement ventilation systems should not propagate spread of fire.	Required for new facilities; as required by the accident analysis for existing facilities (discretionary). Address fire barriers, fire dampers arrangement.	DOE-HDBK-1169 (10.1) DOE-STD-1066
	As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Page 21 and 22 Discussion, the evaluation of internal fire events for an existing facility is only required if the accident analysis takes credit for the active confinement ventilation system.	

Evaluation Criteria	Discussion	Reference
4 - Resistance to External Events – Natural Phenomena – Seismic		
4.1 Confinement ventilation systems should safely withstand earthquakes.	If the active CVS system is not credited in a seismic accident condition there is no need to evaluate that performance and/or design attribute for the confinement ventilation system (discretionary). Also, any seismic impact on the confinement ventilation system performance will be based on the current functional requirements in the DSA. NOTE: Seismic requirements may apply to Defense-in-Depth items indirectly for the protection of safety SSCs.	ASME AG-1 (AA) DOE O 420.1B DOE-HDBK-1169 (9.2)
	As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per 2004-2 Ventilation System Evaluation Guidance Addendum, March 6, 2007, Caution 4 and Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Page 22 Discussion, the evaluation of seismic events is only required if the accident analysis takes credit for the active confinement ventilation system during or after the NPH event.	

	Evaluation Criteria	Discussion	Reference
		5 - Resistance to External Events – Natural Phenomena – Tornado/Wind	
5.1	Confinement ventilation systems should safely withstand tornado depressurization.	If the active CVS is not credited in a tornado condition there is no need to evaluate that performance and/or design attribute for the confinement ventilation system (discretionary). Also, any tornado impact on the confinement ventilation system performance will be based on the current functional requirements in the DSA.	DOE O 420.1B DOE-HDBK-1169 (9.2)
		As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per 2004-2 Ventilation System Evaluation Guidance Addendum, March 6, 2007, Caution 4 and Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Pages 22 and 23 Discussion, the evaluation of tornado and wind events is only required if the accident analysis takes credit for the active confinement ventilation system during or after the NPH event.	
5.2	Confinement ventilation systems should withstand design wind effects on system performance.	If the active CVS is not credited in a wind condition there is no need to evaluate that performance and/or design attribute for the confinement ventilation system (discretionary). Also, any wind impact on the confinement ventilation system performance will be based on the current NP analysis in the DSA.	DOE O 420.1B DOE-HDBK-1169 (9.2)
		As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per 2004-2 Ventilation System Evaluation Guidance Addendum, March 6, 2007, Caution 4 and Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Pages 22 and 23 Discussion, the evaluation of tornado and wind events is only required if the accident analysis takes credit for the active confinement ventilation system during or after the NPH event.	

Evaluation Criteria	Discussion	Reference
6 - Other NP Events (eg. flooding, precipitation)		
6.1 Confinement ventilation system should withstand other NP events considered credible in the DSA where the confinement ventilation system is credited.	If the active confinement ventilation system is not credited for this event there is no need to evaluate that performance and/or design attribute for the confinement ventilation system (discretionary). Also, any impact on the confinement ventilation system performance will be based on the current NP analysis in the DSA.	DOE O 420.1B DOE-HDBK-1169 (9.2)
	As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per 2004-2 Ventilation System Evaluation Guidance Addendum, March 6, 2007, Caution 4 and Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Page 23 Discussion, the evaluation of other NPH events is only required if the accident analysis takes credit for the active confinement ventilation system during or after the NPH event.	

Evaluation Criteria	Discussion	Reference
7 - Range Fires / Dust Storms		
7.1 Administrative controls should be established to protect confinement ventilation systems from barrier threatening events.	Ensure appropriately thought out response to external threat is defined (e.g. pre-fire plan).	DOE O 420.1B
	The Savannah River Forestry Department is responsible for fire fighting efforts in regards to wildland fires. They also have a program of controlled burns and mechanical thinning of underbrush to limit or prevent wildland fires spreading out of control. If the fire encroaches upon SRNL, the Savannah River Site Fire Department will direct extinguishing efforts. Building 773-A has a current Fire Pre Plan and has procedures to reduce confinement ventilation system air flow (originally develop for electrical system maintenance) that will minimize soot loading of the filters in the ventilation systems. Reference: AOP-06-007 Dust storms are not an issue at the Savannah River Site due to the regional climate. <u>Gap Analysis</u> No Gap. Administrative controls are sufficient to protect the confinement ventilation systems for barrier threatening events.	

Evaluation Criteria	Discussion	Reference
	8 - Testability	
8.1 Design supports the periodic inspection and testing of filters and housing, and test and inspections are conducted periodically.	Ability to test for leakage per intent of N510.	DOE-HDBK-1169 (2.3.8) ASME AG-1 ASME N510
	Aerosol efficiency testing is performed on the E-HV Men's Change Room Exhaust sub-system HEPA filter every 18 months. This in-place test capability was added in the 1960's and testing points meet the intent of N510. Note - The E-HV Women's Change Room Exhaust sub-system is unfiltered. Gap Analysis No Gap.	
8.2 Instrumentation required to support system operability is calibrated.	Credited instrumentation should have specified calibration / surveillance requirements. Non-safety instrumentation should be calibrated as necessary to support system functionality.	DOE-HDBK-1169 (2.3.8)
	The E-HV system functional classification is General Service; it is not credited in the DSA to perform a safety function. The E-HV system has no installed instrumentation. If non-safety instrumentation is added to close other gaps, it will be calibrated as needed. Gap Analysis No Gap.	
8.3 Integrated system performance testing is specified and performed.	Required responses assumed in the accident analysis must be periodically confirmed including any time constraints.	DOE-HDBK-1169 (2.3.8)
	The E-HV system functional classification is General Service, it is not credited in the DSA to perform a safety function. No formal integrated system performance testing is required. Airflow direction and differential pressures are verified at key points within the building during periodic air balance testing to verify that the ventilation systems are functioning as intended. Findings are forwarded to the Design Authority Engineer. Results are documented in an Air Balance Test Report, and evaluated for any necessary corrective actions. The last full air balance test for Section E was performed in 2001. Air flow directions between rooms are also verified to support radiological surveys on a routine basis with findings forwarded to the Design Authority Engineer. Gap Analysis No Gap	

Evaluation Criteria	Discussion	Reference
9 - Maintenance		
9.1 Filter service life program should be established.	Filter life (shelf life, service life, total life) expectancy should be determined. Consider: filter environment, maximum delta-P, radiological loading, age, and potential chemical exposure.	DOE-HDBK-1169 (3.1 & App C)
	Per requirements of SRS Engineering Standard 15888, a Filter service life program has been established for this system. This standard is the basis of the Nuclear Air Cleaning Handbook Appendix C. The filters have a maximum shelf life of 3 years and total life of 10 years. Program is tracked using the Computerized Maintenance Management System . Note - The E-HV Women's Change Room Exhaust sub-system is unfiltered. Gap Analysis No Gap.	

Evaluation Criteria	Discussion	Reference
10 - Single Failure		
10.1 Failure of one component (equipment or control) shall not affect continuous operation.	Address potential failures (example failures - fan, backup power supply, switchgear).	DOE O 420.1B (Facility Safety, Chapter I, Sec. 3.b(8))
	<u>E-HV Men's Change Room Exhaust Sub-system</u> No standby fan is provided. The system fan is supplied with normal power only. <u>E-HV Women's Change Room Exhaust Sub-system</u> No standby fan is provided. The system fan is supplied with normal power only. <u>Gap Analysis</u> Gap Number 31: Discretionary Gap - The two sub-systems do not have redundant fans.	
10.2 Automatic backup electrical power shall be provided to all critical instruments and equipment required to operate and monitor the confinement ventilation system.	[DOE Guidance Document does not provide any specific evaluation guidance discussion for this criteria]	DOE-HDBK-1169 (2.2.7)
	<u>E-HV Men's Change Room Exhaust Sub-system</u> The system fan is supplied with normal power only. <u>E-HV Women's Change Room Exhaust Sub-system</u> The system fan is supplied with normal power only. <u>Gap Analysis</u> Gap Number 32: Discretionary Gap - The two sub-systems fans do not have automatic back-up power.	
10.3 Backup electrical power shall be provided to all critical instruments and equipment required to operate and monitor the confinement ventilation system.	NOTE: Safety Class is addressed through previous line.	DOE-HDBK-1169 (2.2.7)
	This evaluation criteria is NOT APPLICABLE, as it is an SS-only criteria. SRNL confinement ventilation systems are evaluated to SC criteria.	

Evaluation Criteria	Discussion	Reference
11 - Other Credited Functional Requirements		
11.1 Address any specific functional requirements for the confinement ventilation system (beyond the scope of those above) credited in the DSA.	[DOE Guidance Document does not provide any specific evaluation guidance discussion for this criteria]	10 CFR 830, Subpart B
	The E-HV system functional classification is General Service, it is not credited in the DSA to perform a safety function. There are no functional requirements for the system credited in the DSA. Gap Analysis No Gap.	

Evaluation Criteria	Discussion	Reference
0 - Ventilation System Description & References		
0.1 System Description	N/A System Description The Section F Process Hood Exhaust (F-PHEX) system is a manifolded exhaust system that exhausts both the primary and secondary confinement zones in 773-A Section F. Exhaust air is drawn from the service galleries and support areas on the main floor and the operating areas on the service floor, into the high bay experimental area (center portion of F Section) or lab modules on the main floor. Three large exhaust fans, located on the east roof of F Section, provide up to 40,000 cfm exhaust (normally provided by two of the three installed fans). See Attachment 11 Figure B for a schematic of the system). Fourteen (14) connections points are provided to the exhaust fan inlet plenum. These connection points serve either room risers that exhaust the secondary confinement zone or primary confinement zones such as Shielded Cells (Medical Source Facility and Californium Process Facility), Fume Hoods (F-003, SED or REALS), Gloveboxes (AD&D and SED) or special process enclosures (CPF and AD&D). All exhaust air is routed through HEPA filters and discharged to the Area Sand Filter and 791-A stack. The building shell, walls and roof associated with the PHEX system are qualified to PC-1.	N/A

Evaluation Criteria	Discussion	Reference
0.2 System References	N/A	N/A
	System Design Descriptions o M-SYD-A-00023, F-Section Supply and Exhaust Systems, 773-A, System Design Description o T-CLC-A-00011, F Wing Fragility Analysis, T-CLC-A-00011 o M-SYD-A-00024, IA, PLTA & Compressor Alternate CW o E-SYD-A-00008, 773-A D/G Standby Power System o G-SYD-A-00002, SRNL Sand Filter System Design Description Test Procedures o TO-06-017, Rotation of Section F Exhaust System Fans o TO-06-038, Testing of Interlocks between Section F Exhaust Fan System and Diversion Fans o TP-02-773A-FWING-02, 773-A, F Wing Air Balance Report o 5Q1.2, Procedure 484, Building Air Survey o TO-05-027, 773-A D/G Annual Design Load Test Round Sheets and Other Procedures o ROD-OPS-2002-002 - Control Area Operator (CAO) Round Sheets o ROD-OPS-2002-003 - Facility Operator (FO) Round Sheets o AOP-06-007, Wildland Fire, Facility Ventilation Shutdown and/or Evacuation o AOP-06-005, 773-A Section F Reduced Ventilation and/or Loss of Alarms Standards o DuPont Engineering Specifications 3027, 3017, 5998, 7591, 8728, H16J, SH1A. o SRS Procurement Specification M-SPP-G-00243, HEPA Filter Specification o SRS Engineering Standard 15888, HEPA Filter Requirements o DOE-STD-3020-2005, DOE Technical Standard - Specification for HEPA Filters Used by DOE Contractors o DOE-STD-3025-2007, DOE Technical Standard - Quality Assurance Inspection and Testing of HEPA Filters o UL 586, UL Standard for Safety, High Efficiency, Particulate, Air Filter Units, 1996 o ANSI/ASME NQA-1, Quality Assurance Program Requirements for Nuclear Facilities Miscellaneous o Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, January 2006 o 2004-2 Ventilation System Evaluation Guidance Addendum, March 2007 o SRNL-ROE-2007-00063, SRNL Table 4-3 Submittal to DOE-SR, April 2007 o WSRC-SA-2, SRNL Technical Area (TA) Documented Safety Analysis (DSA), Revision 3 o WSRC-TS-97-00014, SRNL Technical Area (TA) Technical Safety Requirements (TSRs), Revision 4 o SRNL-ESD-2007-00017, Structural Integrity Program Scope, Resources & Estimate, February 2007	

Evaluation Criteria	Discussion	Reference
1 - Ventilation System – General Criteria		
1.1 Pressure differential should be maintained between zones and atmosphere.	Number of zones as credited by accident analysis to control hazardous material release; demonstrate by use considering potential in-leakage. The F-Section Process Hood Exhaust system (F-PHEX) exhausts primary confinement enclosures in F-section as follows: The Californium Packaging Facility (CPF) "hot cells", the Medical Source Facility (MSF) "hot cells"; gloved enclosures including the Alpha Decontamination and Decommissioning enclosure (AD&D), four gloveboxes, and five radiological/chemical hoods. All of these enclosures except three rad/chem hoods are inactive, but all serve to confine contamination from legacy materials. The Section F Process Hood Exhaust System ductwork between the CPF and MSF cells through a testable HEPA filter is credited in the facility Safety Basis for passive confinement only (SS function). The F-PHEX fans maintain sufficient air flow from the cells to establish a primary confinement zone therein. The F-PHEX system gloveboxes contain inventories below Hazard Category 3 thresholds per DOE-STD-1027-92 and thus may be classified as General Service (GS). The gloveboxes are maintained at a vacuum of 0.5 to 1.0 in. wc relative to the surrounding space by the F-PHEX system. The F-PHEX system fans have abundant capacity to induce an inward air flow in the event of an open gloveport or passthrough in order to confine radiological materials. The F-PHEX system is sized to ensure an adequate inflow of air in the event of a credible confinement breach for affected enclosures and cells. <u>Gap Analysis</u> No Gap	DOE-HDBK-1169 (2.2.9) ASHRAE Design Guide
1.2 Materials of construction should be appropriate for normal, abnormal and accident conditions.	[DOE Guidance Document does not provide any specific evaluation guidance discussion for this criteria] The F-PHEX system ductwork is fabricated from stainless steel sheet 20 ga. or greater thickness, of welded construction. The material was selected to be resistant to corrosion resulting from chemical fumes and moisture, anticipated from chemical production and research activities. System dampers are also constructed from stainless steel with chemically resistant valve trim. The filter housings are also constructed from grade 304 stainless steel and use neoprene gaskets for chemical resistance. The system fans are constructed from carbon steel with applied protective coatings. The facility has implemented a system integrity inspection program whereby vital system ductwork is checked for wall thickness and corrosion damage. The system was installed ~40 years ago and system physical degradation is not evident. The F-PHEX exhaust ducts from the CPF and MSF cells are credited in the facility safety basis with passive confinement of radiological material up to and including a testable HEPA filter. <u>Gap Analysis</u> No Gap. Materials of construction are appropriate for normal, abnormal and accident conditions.	DOE-HDBK-1169 (2.2.5) ASME AG-1

Evaluation Criteria	Discussion	Reference
1.3 Exhaust system should withstand anticipated normal, *abnormal and accident* system conditions and maintain confinement integrity.	As required by accident analysis to prevent accident release.	DOE-HDBK-1169 (2.4) ASHRAE Design Guide
	The F-PHEX system facilitates the confinement feature of various F-section enclosures. (See evaluation 1.1-GC1 above) An accident event to be evaluated is an explosion from glovebox overpressurization. There are four gloveboxes exhausted by the F-PHEX system through two stages of HEPA filtration. The filter housings are not co-located with the gloveboxes, so a glovebox accident would not directly affect the HEPA filter availability. If the accident resulted in a minor breach of the confinement boundary, the exhaust system would effectively purge the glovebox through the HEPA filter in normal fashion. If an explosion breached a glovebox dispersing the radioactive inventory into the room, the local room exhaust inlet is provided with a testable HEPA filter to control release of contamination. The local room exhaust flows to the area sandfilter before discharge to the environment providing defense-in-depth protection. Process flammable gas generated in an individual glovebox would be diluted many times below the lower flammable limit prior to entering the filter housing. Thus an explosion involving the F-PHEX filter housing is not credible. The HEPA filter housings are a totally enclosed design. They have inherent resistance to the effects of external events. The system is not credited in the DSA with surviving an NPH (earthquake) event . <u>Gap Analysis</u> No Gap.	

Evaluation Criteria	Discussion	Reference
1.4 Confinement ventilation systems shall have appropriate filtration to minimize release.	Address: 1) Type of filter (e.g., HEPA, sand, sintered metal); 2) Filter sizing (flow capacity and pressure drop); 3) Decontamination Factor vs. accident analysis assumptions. Nuclear Grade HEPA filters are procured to SRS Specification M-SPP-G-00243 which incorporates the requirements of ASME AG-1. All F-PHEX system enclosures are exhausted through HEPA filters which are periodically leak tested in place to ensure a filtration efficiency of 99.95%. This efficiency was qualitatively selected to ensure that the HEPA filter is properly installed to support the passive confinement function. Prior to receipt the filters are tested at the Independent Filter Testing Facility (FTF) to confirm an efficiency of at least 99.97% for a decontamination factor DF = 3333. Decontamination factor has not been considered in the facility DSA. The HEPA filters serving the F-Section shielded cells Californium Packaging Facility and Medical Source Facility (CPF and MSF) are installed in totally enclosed stainless steel housings. CPF exhausts through two testable stages, MSF has one testable filtration stage. The CPF exhaust design flow is 1025 CFM. The nominal maximum capacity of the exhaust HEPA filter is 1000 CFM. The normal exhaust flow, as measured by the most recent air balance procedure, is approximately 825 CFM. The MSF exhaust design flow is 400 CFM. The system has two parallel HEPA filters, each with a capacity of 250 CFM. F-section radiohoods and chemical hoods exhaust through testable HEPA filters: The Radiological Evidence Analysis Laboratory Suites (REALS) has two hoods with a combined exhaust of 1900 (CFM design). The associated HEPA filter housing has two parallel 1500 CFM filters installed for a total capacity of 3000 CFM. The F-003 lab in has two hoods with a combined measured exhaust of 1505 CFM. This exhaust passes through two stages of HEPA filters, the first with a single 1000 CFM capacity HEPA filter and the second with two parallel 1250 CFM capacity filters (2500 cfm capacity). Since the air is properly filtered by the second stage of HEPA filtration and then by the sand filter before it reaches the environment. The over flowing of the first stage of HEPA filtration is not considered a gap. <u>Gap Analysis</u> No gaps.	ASME AG-1 DOE-HDBK-1169 (2.2.1)

Evaluation Criteria	Discussion	Reference
2 - Ventilation System – Instrumentation & Control		
2.1 Provide system status instrumentation and/or alarms.	Address key information to ensure system operability (e.g., system delta-P, filter pressure drop).	ASME AG-1 DOE-HDBK-1169 ASHRAE Design Guide (Section 4)
	Differential pressure gauges are installed to measure room to GB DP for F-PHEX system gloveboxes. Twelve of the fourteen main exhaust branches have automatic control dampers which adjust the branch static pressure to compensate for the gradual loading of the branch HEPA filters. The F-PHEX exhaust fans static pressure is monitored at the fans control panel and low static pressure condition alarms in the main control room. Exhaust air temperature indication is not required. The system handles ambient, conditioned air exhausted from the F-section high bay and laboratory rooms. Differential pressure between primary confinement (CPF & MSF cells) is not credited in the facility safety basis. However, DOE-HNBK-1169-2003, Table 2.6 lists air flow criteria for hot cells: "A vacuum equal to or greater than 1 in.wc relative to surrounding spaces must be maintained at all times to ensure a positive flow of air into the confinement ". Currently cell differential pressure is not monitored. Glovebox outlet HEPA filter DP instrumentation is not installed on the four F-PHEX system gloveboxes. Two HEPA filtration flow paths (CPF Cells and MSF Cells) have no pressure instrumentation to measure HEPA filter housing differential pressure. <u>Gap Analysis</u> Gap Number 50: Discretionary Gap - For CPF and MSF, Cell Differential Pressure is not monitored. Gap Number 51: Discretionary Gap - For four gloveboxes, outlet HEPA filters are not provided with ΔP instrumentation. Gap Number 52: Discretionary Gap - For CPF and MSF, the outlet HEPA filters are not provided with ΔP instrumentation.	

Evaluation Criteria	Discussion	Reference
2.2 Interlock supply and exhaust fans to prevent positive pressure differential.	[DOE Guidance Document does not provide any specific evaluation guidance discussion for this criteria] The F-section supply and exhaust fans are interlocked to prevent a positive pressure differential. The F-section supply fans are controlled by the F-PHEX fans such that the lead supply fan will not start unless the exhaust fan plenum static pressure is below - 3 in. wc. The second supply fan will not start unless the exhaust fan inlet plenum static pressure is below -5 in. wc. Gap Analysis No Gap	DOE-HDBK-1169 ASHRAE Design Guide (Section 4)
2.3 Post accident indication of filter break-through.	Instrumentation supports post accident planning and response; should be considered critical instrumentation for SC. The F-PHEX system effluent is monitored by a sampling system located at the sand filter inlet duct after mixing with the exhaust from other process exhaust systems. Gap Analysis No Gaps	TECH-34
2.4 Reliability of control system to maintain confinement function under normal, abnormal and accident conditions.	Address, for example, impacts of potential common mode failures from events that would require active confinement function. Ref. Table 4.3, Attachment 4, the accidents evaluated for F-section are as follows: Spill Process Flammable Gas Explosion (with no consequential fire) Distributed Flammable Gas Explosion (with no consequential fire) Glovebox Overpressurization <evaluated with the OGE system> The unmitigated consequences offsite for a spill <.31 REM>, and a process flammable gas explosion <.31 REM> are do not challenge the evaluation guidelines. The glovebox overpressurization event has been evaluated with the OGE system. The distributed flammable gas explosion event requires no further evaluation because flammable gas is no longer supplied to F-section. Ref. dwg. W162102, note 2. Gap Analysis No Gap.	DOE-HDBK-1169 (2.4)

Evaluation Criteria	Discussion	Reference
2.5 Control components should fail safe.	[DOE Guidance Document does not provide any specific evaluation guidance discussion for this criteria]	DOE-HDBK-1169 (2.4)
	The three PHEX system fans are aligned as two operating, one in standby to provide redundancy. The fans are operated from the F-PHEX control panel. Each fan has an automatic inlet damper to prevent backflow through the idle fan. An anticipated equipment failure resulting in loss of instrument air to F-section would have a detrimental effect on the air operated inlet dampers for the F-PHEX fans. Under this scenario, the inlet dampers for the operating fans would close or oscillate from the flow effects of the exhaust air. The inlet dampers are not spring loaded to move to a safe position in case of instrument air loss. Process ventilation for the F-section process enclosures would be impaired in this case because the dampers would be free to move from the system flow effects. <u>Gap Analysis</u> Gap Number 53: Discretionary Gap - The exhaust fan inlet dampers do not fail safe.	

Evaluation Criteria	Discussion	Reference
3 - Resistance to Internal Events – Fire		
3.1 Confinement ventilation systems should withstand credible fire events and be available to operate and maintain confinement.	Required for new facilities; as required by the accident analysis for existing facilities (discretionary). Must address protection of filter media.	DOE-HDBK-1169 (10.1) DOE-STD-1066
	As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Page 21 and 22 Discussion, the evaluation of internal fire events for an existing facility is only required if the accident analysis takes credit for the active confinement ventilation system.	
3.2 Confinement ventilation systems should not propagate spread of fire.	Required for new facilities; as required by the accident analysis for existing facilities (discretionary). Address fire barriers, fire dampers arrangement.	DOE-HDBK-1169 (10.1) DOE-STD-1066
	As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Page 21 and 22 Discussion, the evaluation of internal fire events for an existing facility is only required if the accident analysis takes credit for the active confinement ventilation system.	

Evaluation Criteria	Discussion	Reference
4 - Resistance to External Events – Natural Phenomena – Seismic		
4.1 Confinement ventilation systems should safely withstand earthquakes.	If the active CVS system is not credited in a seismic accident condition there is no need to evaluate that performance and/or design attribute for the confinement ventilation system (discretionary). Also, any seismic impact on the confinement ventilation system performance will be based on the current functional requirements in the DSA. NOTE: Seismic requirements may apply to Defense-in-Depth items indirectly for the protection of safety SSCs.	ASME AG-1 (AA) DOE O 420.1B DOE-HDBK-1169 (9.2)
	As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per 2004-2 Ventilation System Evaluation Guidance Addendum, March 6, 2007, Caution 4 and Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Page 22 Discussion, the evaluation of seismic events is only required if the accident analysis takes credit for the active confinement ventilation system during or after the NPH event.	

Evaluation Criteria	Discussion	Reference
5 - Resistance to External Events – Natural Phenomena – Tornado/Wind		
5.1 Confinement ventilation systems should safely withstand tornado depressurization.	If the active CVS is not credited in a tornado condition there is no need to evaluate that performance and/or design attribute for the confinement ventilation system (discretionary). Also, any tornado impact on the confinement ventilation system performance will be based on the current functional requirements in the DSA. As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per 2004-2 Ventilation System Evaluation Guidance Addendum, March 6, 2007, Caution 4 and Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Pages 22 and 23 Discussion, the evaluation of tornado and wind events is only required if the accident analysis takes credit for the active confinement ventilation system during or after the NPH event.	DOE O 420.1B DOE-HDBK-1169 (9.2)
5.2 Confinement ventilation systems should withstand design wind effects on system performance.	If the active CVS is not credited in a wind condition there is no need to evaluate that performance and/or design attribute for the confinement ventilation system (discretionary). Also, any wind impact on the confinement ventilation system performance will be based on the current NP analysis in the DSA. As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per 2004-2 Ventilation System Evaluation Guidance Addendum, March 6, 2007, Caution 4 and Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Pages 22 and 23 Discussion, the evaluation of tornado and wind events is only required if the accident analysis takes credit for the active confinement ventilation system during or after the NPH event.	DOE O 420.1B DOE-HDBK-1169 (9.2)

Evaluation Criteria	Discussion	Reference
6 - Other NP Events (eg. flooding, precipitation)		
6.1 Confinement ventilation system should withstand other NP events considered credible in the DSA where the confinement ventilation system is credited.	If the active confinement ventilation system is not credited for this event there is no need to evaluate that performance and/or design attribute for the confinement ventilation system (discretionary). Also, any impact on the confinement ventilation system performance will be based on the current NP analysis in the DSA.	DOE O 420.1B DOE-HDBK-1169 (9.2)
	As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per 2004-2 Ventilation System Evaluation Guidance Addendum, March 6, 2007, Caution 4 and Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Page 23 Discussion, the evaluation of other NPH events is only required if the accident analysis takes credit for the active confinement ventilation system during or after the NPH event.	

	Evaluation Criteria	Discussion	Reference
		7 - Range Fires / Dust Storms	
7.1	Administrative controls should be established to protect confinement ventilation systems from barrier threatening events.	Ensure appropriately thought out response to external threat is defined (e.g. pre-fire plan).	DOE O 420.1B
		The Savannah River Forestry Department is responsible for fire fighting efforts in regards to wildland fires. They also have a program of controlled burns and mechanical thinning of underbrush to limit or prevent wildland fires spreading out of control. If the fire encroaches upon SRNL, the Savannah River Site Fire Department will direct extinguishing efforts. Building 773-A has a current Fire Pre Plan and has procedures to reduce confinement ventilation system air flow (originally develop for electrical system maintenance) that will minimize soot loading of the filters in the ventilation systems. Reference: AOP-06-007 Dust storms are not an issue at the Savannah River Site due to the regional climate. <u>Gap Analysis</u> No Gap. Administrative controls are sufficient to protect the confinement ventilation systems for barrier threatening events.	

Evaluation Criteria	Discussion	Reference
	8 - Testability	
8.1 Design supports the periodic inspection and testing of filters and housing, and test and inspections are conducted periodically.	Ability to test for leakage per intent of N510.	DOE-HDBK-1169 (2.3.8) ASME AG-1 ASME N510
	The F-PHEX system HEPA filter housings are totally enclosed units, many having bag-in/bag-out feature. The filter housings have all of the features prescribed in ASME N510, Section 10 to facilitate in-place HEPA filter testing, i.e injection ports and sample ports to support HEPA filter aerosol testing. In-place leak testing of HEPA filter installation is performed in accordance with Manual 2Y1 "HEPA Filter Testing Procedures", Procedure 104 "General Surveillance Testing of HEPA Filters" In-place leak testing is performed at scheduled intervals for installed testable HEPA filter systems to detect deterioration of filters, gaskets or other causes that could result in leaks. The facility has established a TSR surveillance requirement to perform in place aerosol testing of the HEPA filters at 18 month intervals. <u>Gap Analysis</u> Gap Number 54: Discretionary Gap - For MSF the tape-in-place HEPA filters do not meet the filter housing pressure boundary integrity testing requirements in N510.	
8.2 Instrumentation required to support system operability is calibrated.	Credited instrumentation should have specified calibration / surveillance requirements. Non-safety instrumentation should be calibrated as necessary to support system functionality.	DOE-HDBK-1169 (2.3.8)
	None of the F-PHEX system instrumentation is credited in the DSA with preventing or mitigating a design basis accident. Therefore there are no TSR surveillance calibrations implemented. However, some non-safety instrumentation is calibrated regularly to ensure proper operation of the control system (ex., all three F-PHEX flow switches at the fans are calibrated annually; F supply/exhaust interlock pressure switches are on a three-year calibration cycle). Other system non-safety instrumentation is calibrated only on an as-needed basis, there is no established calibration frequency. <u>Gap Analysis</u> No Gap	

Evaluation Criteria	Discussion	Reference
8.3 Integrated system performance testing is specified and performed.	Required responses assumed in the accident analysis must be periodically confirmed including any time constraints. Functional testing of the interlocks between the F-PHEX fans and the Sandfilter Diversion Fans is performed monthly. Airflow direction and differential pressures are verified at key points within the building during periodic air balance testing to ensure that the ventilation systems are functioning as intended. Results are documented in an Air Balance Test Report, and evaluated for any necessary corrective actions. Airflow directions between rooms are also verified to as part of radiological surveys with findings forwarded to the Design Authority Engineer. <u>Gap Analysis</u> No Gap.	DOE-HDBK-1169 (2.3.8)

Evaluation Criteria	Discussion	Reference
	9 - Maintenance	
9.1 Filter service life program should be established.	Filter life (shelf life, service life, total life) expectancy should be determined. Consider: filter environment, maximum delta-P, radiological loading, age, and potential chemical exposure. Per requirements of SRS Engineering Standard 15888, a Filter service life program has been established for this system. This standard is the basis of the Nuclear Air Cleaning Handbook Appendix C. The filters have a maximum shelf life of 3 years and total life of 10 years. Program is tracked using the Computerized Maintenance Management System . Filter environment is considered. The F-PHEX filters exhaust the area confinement cells and enclosures. Air drawn into the enclosures is ambient temperature indoor conditioned air with a relative humidity ~ 50%. Therefore moisture accumulation that will adversely affect the filter media is not expected. Although not previously encountered in the F-PHEX system, moisture laden filters are replaced when discovered. Gap Analysis No Gap	DOE-HDBK-1169 (3.1 & App C)

Evaluation Criteria	Discussion	Reference
10 - Single Failure		
10.1 Failure of one component (equipment or control) shall not affect continuous operation.	Address potential failures (example failures - fan, backup power supply, switchgear).	DOE O 420.1B (Facility Safety, Chapter I, Sec. 3.b(8))
	The three F-PHEX fans are aligned as two operating, one in standby to provide redundancy. A fan failure is indicated as an alarm in the main control room. The standby fan starts automatically to restore full system operability. The two supply fans are powered from separate motor control centers, and the three exhaust fans are powered from two separate motor control centers. Gap Analysis Gap Number 55: Discretionary Gap - Fan MCCs are not distributed across different D/Gs.	
10.2 Automatic backup electrical power shall be provided to all critical instruments and equipment required to operate and monitor the confinement ventilation system.	[DOE Guidance Document does not provide any specific evaluation guidance discussion for this criteria]	DOE-HDBK-1169 (2.2.7)
	The 773-A D/G, EEP-DG-001, automatically provides standby power for the F Section exhaust system, which is not credited in the Safety Basis to actively mitigate consequences of any accident scenarios. Standby power is also automatically provided for the F-section supply fans. Gap Analysis No Gap	
10.3 Backup electrical power shall be provided to all critical instruments and equipment required to operate and monitor the confinement ventilation system.	NOTE: Safety Class is addressed through previous line.	DOE-HDBK-1169 (2.2.7)
	This evaluation criteria is NOT APPLICABLE, as it is an SS-only criteria. SRNL confinement ventilation systems are evaluated to SC criteria.	

Evaluation Criteria	Discussion	Reference
11 - Other Credited Functional Requirements		
11.1 Address any specific functional requirements for the confinement ventilation system (beyond the scope of those above) credited in the DSA.	[DOE Guidance Document does not provide any specific evaluation guidance discussion for this criteria]	10 CFR 830, Subpart B
	For the CPF and MSF exhausts, section F PHEX ducting up to and including the testable stages of HEPA filters is functionally classified as Safety Significant. This passive function provides confinement and filtration of airborne radionuclides. The filters are not credited with a dose reduction function. Therefore no additional DSA credited system functions will be identified. Gap Analysis No Gap	

Evaluation Criteria	Discussion	Reference
0 - Ventilation System Description & References		
0.1 System Description	N/A <u>System Description</u> A double-lab module, intended for chemical use only, is located in rooms F-101/107. The lab is equipped with four chemical hoods. These hoods have two dedicated exhaust fans and HEPA-filtered exhaust (the labs were originally intended for low-level radiation use) to a local stack. An auxiliary supply fan supplies air directly above each hood to supplement the building supply air. The auxiliary air system was designed and installed to help maintain proper air balance after installation of the double lab module. Both labs have always operated as non-radiological laboratories (WSRC-SA-2, Rev. 3, Section 2.4.1.6). The building shell, walls and roof associated with the LHEX system are qualified to PC-1.	N/A

Evaluation Criteria	Discussion	Reference
0.2 System References	N/A	N/A
	System Design Descriptions o F-Section Supply and Exhaust Systems, 773-A, System Design Description, M-SYD-A-00023, Rev. 4 o ST5-23147, ST5-23148 - Lab Room F-101 Hood Exhaust, Sheets 1&2 o ST5-23150, ST5-23160 - Lab Room F-101 Hood Exhaust & Supply, Electrical, Sheets 1&2 o T-CLC-A-00011, F Wing Fragility Analysis o M-SYD-A-00024, IA, PLTA & Compressor Alternate CW o E-SYD-A-00008, 773-A D/G Standby Power System Test Procedures o TP-02-773A-FWING-02, 773-A, F Wing Air Balance Report o 5Q1.2, Procedure 484, Building Air Survey o TO-05-027, 773-A D/G Annual Design Load Test Round Sheets and Other Procedures o ROD-OPS-2002-002 - Control Area Operator (CAO) Round Sheets o ROD-OPS-2002-003 - Facility Operator (FO) Round Sheets o AOP-06-007, Wildland Fire, Facility Ventilation Shutdown and/or Evacuation Standards o DuPont Engineering Specifications 3027, 3017, 5998, 7591, 8728, H16J, SH1A. o SRS Procurement Specification M-SPP-G-00243, HEPA Filter Specification o SRS Engineering Standard 15888, HEPA Filter Requirements o DOE-STD-3020-2005, DOE Technical Standard - Specification for HEPA Filters Used by DOE Contractors o DOE-STD-3025-2007, DOE Technical Standard - Quality Assurance Inspection and Testing of HEPA Filters o UL 586, UL Standard for Safety, High Efficiency, Particulate, Air Filter Units, 1996 o ANSI/ASME NQA-1, Quality Assurance Program Requirements for Nuclear Facilities Miscellaneous o Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, January 2006 o 2004-2 Ventilation System Evaluation Guidance Addendum, March 2007 o SRNL-ROE-2007-00063, SRNL Table 4-3 Submittal to DOE-SR, April 2007 o WSRC-SA-2, SRNL Technical Area (TA) Documented Safety Analysis (DSA), Revision 3 o WSRC-TS-97-00014, SRNL Technical Area (TA) Technical Safety Requirements (TSRs), Revision 4 o SRNL-ESD-2007-00017, Structural Integrity Program Scope, Resources & Estimate, February 2007	

Evaluation Criteria	Discussion	Reference
1 - Ventilation System – General Criteria		
1.1 Pressure differential should be maintained between zones and atmosphere.	Number of zones as credited by accident analysis to control hazardous material release; demonstrate by use considering potential in-leakage. <u>Confinement Zones</u> • Primary Confinement F-101/107 Lab Hoods/ Ducting through 1st testable HEPA filter stage • Secondary Confinement F-101/107 lab modules • Tertiary Confinement F-190 Corridor and adjacent storage areas The confinement zones associated with Lab F-101/107 are not credited in the DSA with preventing or mitigating a design basis accident. All of the equipment is classified as General Service (GS). However, the essential elements of the DOE Nuclear Air Cleaning Handbook, DOE-HNBK-1169-2003, Table 2.8 are met. The hoods are annually certified to meet the prescribed face velocity of 80-100 linear FPM as recommended by the ACGIH Industrial Ventilation Manual. Air flow is from the secondary zone to the primary zone. Each hood has an exhaust damper for air balancing and isolation to prevent backflow when out of service. The F-101/107 lab modules are maintained at a negative pressure relative to the adjacent corridor and rooms (tertiary zone). <u>Gap Analysis</u> No Gap.	DOE-HDBK-1169 (2.2.9) ASHRAE Design Guide
1.2 Materials of construction should be appropriate for normal, abnormal and accident conditions.	[DOE Guidance Document does not provide any specific evaluation guidance discussion for this criteria] The F-LHEX system ductwork is fabricated from stainless steel sheet 24 ga. or greater thickness, of welded construction. The material was selected to be resistant to corrosion resulting from chemical fumes and moisture, anticipated from chemical reagents and research activities. System dampers are also constructed from stainless steel with chemically resistant valve trim. The filter housings are also constructed from grade 304 stainless steel and use neoprene gaskets for chemical resistance. The system fans, located downstream of the HEPA filters, are constructed from carbon steel. <u>Gap Analysis</u> No Gap. Materials of construction are appropriate for normal, abnormal and accident conditions.	DOE-HDBK-1169 (2.2.5) ASME AG-1

Evaluation Criteria	Discussion	Reference
1.3 Exhaust system should withstand anticipated normal, abnormal and accident system conditions and maintain confinement integrity.	As required by accident analysis to prevent accident release.	DOE-HDBK-1169 (2.4) ASHRAE Design Guide
	The following accident scenarios are considered. Process explosion -- accumulation of propane, oxygen, hydrogen, acetylene gas etc. or benzene, formic acid or other flammable chemicals etc. stored in lab explode external to containment. --Ventilation systems would operate normally to maintain a positive pressure differential into the affected lab. Exhaust flows through HEPA filtration are believed adequate to contain mobilized contaminants. If the HEPA filter plugs, the contaminants would be contained within the lab and ductwork. Lab walls and ductwork would passively contain contaminants. Explosion -- Accumulation of Distributed Flammable Gas with no consequential fire - Not applicable. F-Section has no distributed flammable gas. The propane supply valves are administratively controlled closed. Drop / Spill -- Ventilation systems would operate normally to draw room air toward the hoods. Normal room infiltration would contain the spill to the F-101/107. The design exhaust flow from the lab module is 4200 CFM. This robust flow would effectively control airborne hazardous chemicals. Exhaust flows through HEPA filtration are believed adequate to contain mobilized contaminants. If the HEPA plugs, the contaminants would be contained within the lab and ductwork. If filter housings or ducting are compromised, the F-PHEX duct systems would contain the hazardous material. Gap Analysis No Gap.	

Evaluation Criteria	Discussion	Reference
1.4 Confinement ventilation systems shall have appropriate filtration to minimize release.	Address: 1) Type of filter (e.g., HEPA, sand, sintered metal); 2) Filter sizing (flow capacity and pressure drop); 3) Decontamination Factor vs. accident analysis assumptions. Nuclear Grade HEPA filters are procured to SRS Specification M-SPP-G-00243 which incorporates the requirements of ASME AG-1. The F-LHEX system enclosures are exhausted through HEPA filters which are periodically leak tested in place to ensure a filtration efficiency of 99.95%. This efficiency was qualitatively selected to ensure that the HEPA filter is properly installed to support the passive confinement function. Prior to receipt the filters are tested at the Independent Filter Testing Facility (FTF) to confirm an efficiency of at least 99.97% for a decontamination factor DF = 3333. Decontamination factor has not been considered in the facility DSA. The HEPA filters serving the F-101/107 laboratory fume hoods are installed in totally enclosed stainless steel housings with bag-in, bag-out filter changeout feature. The design system exhaust flow is 4200 CFM. The HEPA filter housing has four (4) 1500 CFM rated filters arranged in parallel to adequately handle the maximum expected LHEX flow. <u>Gap Analysis</u> No Gap.	ASME AG-1 DOE-HDBK-1169 (2.2.1)

Evaluation Criteria	Discussion	Reference
2 - Ventilation System – Instrumentation & Control		
2.1 Provide system status instrumentation and/or alarms.	Address key information to ensure system operability (e.g., system delta-P, filter pressure drop).	ASME AG-1 DOE-HDBK-1169 ASHRAE Design Guide (Section 4)
	The F-LHEX ventilation system has no status instrumentation or alarms. <u>Gap Analysis</u>: Gap Number 45: Discretionary Gap - HEPA filters are not provided with ΔP instrumentation. Gap Number 46: Discretionary Gap - The system does not have any status instrumentation or alarms.	
2.2 Interlock supply and exhaust fans to prevent positive pressure differential.	[DOE Guidance Document does not provide any specific evaluation guidance discussion for this criteria]	DOE-HDBK-1169 ASHRAE Design Guide (Section 4)
	The supply fan is electrically interlocked with the exhaust fans. An exhaust fan must be running before the supply fan can be started and stopping the LHEX fan will stop the supply fan A supply fan start/stop control button station is provided in F-101. <u>Gap Analysis</u> No Gap	
2.3 Post accident indication of filter break-through.	Instrumentation supports post accident planning and response; should be considered critical instrumentation for SC.	TECH-34
	The F-LHEX hoods are used exclusively as chemical fume hoods. A stack sampling system is installed but is not operational. <u>Gap Analysis:</u> Gap Number 47: Discretionary Gap - Emission point from tertiary confinement zone does not have post accident indication of filter break through.	

Evaluation Criteria	Discussion	Reference
2.4 Reliability of control system to maintain confinement function under normal, abnormal and accident conditions.	Address, for example, impacts of potential common mode failures from events that would require active confinement function. Controls are minimal in the F-LHEX system. Existing auxiliary supply fan start interlock is sufficient for current system use. The labs were originally intended, designed, built (1980's) for low-level radiation work within its four fume hoods. Since 1997, the labs have been used for chemical service (non-radiological) by the Defense Waste Processing Technical (DWPT) group at SRNL. DWPT performs batching of chemicals for glass production, melting of the batches, grinding of the glasses and leach testing on the experimental glass. Although designed and installed for low level radiological & chemical service, both labs have always operated as non-radiological laboratories (WSRC-SA-2, Rev. 3, Section 2.4.1.6). <u>GAP Analysis:</u> No Gap.	DOE-HDBK-1169 (2.4)
2.5 Control components should fail safe.	[DOE Guidance Document does not provide any specific evaluation guidance discussion for this criteria] Controls are simple and minimal in the F-LHEX system. Existing auxiliary supply fan start interlock is sufficient for current system use. Although designed and installed for low level radiological & chemical service, both labs have always operated as non-radiological laboratories. <u>GAP Analysis:</u> No Gap.	DOE-HDBK-1169 (2.4)

Evaluation Criteria	Discussion	Reference
3 - Resistance to Internal Events – Fire		
3.1 Confinement ventilation systems should withstand credible fire events and be available to operate and maintain confinement.	Required for new facilities; as required by the accident analysis for existing facilities (discretionary). Must address protection of filter media.	DOE-HDBK-1169 (10.1) DOE-STD-1066
	As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Page 21 and 22 Discussion, the evaluation of internal fire events for an existing facility is only required if the accident analysis takes credit for the active confinement ventilation system.	
3.2 Confinement ventilation systems should not propagate spread of fire.	Required for new facilities; as required by the accident analysis for existing facilities (discretionary). Address fire barriers, fire dampers arrangement.	DOE-HDBK-1169 (10.1) DOE-STD-1066
	As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Page 21 and 22 Discussion, the evaluation of internal fire events for an existing facility is only required if the accident analysis takes credit for the active confinement ventilation system.	

Evaluation Criteria	Discussion	Reference
4 - Resistance to External Events – Natural Phenomena – Seismic		
4.1 Confinement ventilation systems should safely withstand earthquakes.	If the active CVS system is not credited in a seismic accident condition there is no need to evaluate that performance and/or design attribute for the confinement ventilation system (discretionary). Also, any seismic impact on the confinement ventilation system performance will be based on the current functional requirements in the DSA. NOTE: Seismic requirements may apply to Defense-in-Depth items indirectly for the protection of safety SSCs.	ASME AG-1 (AA) DOE O 420.1B DOE-HDBK-1169 (9.2)
	As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per 2004-2 Ventilation System Evaluation Guidance Addendum, March 6, 2007, Caution 4 and Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Page 22 Discussion, the evaluation of seismic events is only required if the accident analysis takes credit for the active confinement ventilation system during or after the NPH event.	

Evaluation Criteria	Discussion	Reference
5 - Resistance to External Events – Natural Phenomena – Tornado/Wind		
5.1 Confinement ventilation systems should safely withstand tornado depressurization.	If the active CVS is not credited in a tornado condition there is no need to evaluate that performance and/or design attribute for the confinement ventilation system (discretionary). Also, any tornado impact on the confinement ventilation system performance will be based on the current functional requirements in the DSA.	DOE O 420.1B DOE-HDBK-1169 (9.2)
	As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per 2004-2 Ventilation System Evaluation Guidance Addendum, March 6, 2007, Caution 4 and Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Pages 22 and 23 Discussion, the evaluation of tornado and wind events is only required if the accident analysis takes credit for the active confinement ventilation system during or after the NPH event.	
5.2 Confinement ventilation systems should withstand design wind effects on system performance.	If the active CVS is not credited in a wind condition there is no need to evaluate that performance and/or design attribute for the confinement ventilation system (discretionary). Also, any wind impact on the confinement ventilation system performance will be based on the current NP analysis in the DSA.	DOE O 420.1B DOE-HDBK-1169 (9.2)
	As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per 2004-2 Ventilation System Evaluation Guidance Addendum, March 6, 2007, Caution 4 and Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Pages 22 and 23 Discussion, the evaluation of tornado and wind events is only required if the accident analysis takes credit for the active confinement ventilation system during or after the NPH event.	

Evaluation Criteria	Discussion	Reference
6 - Other NP Events (eg. flooding, precipitation)		
6.1 Confinement ventilation system should withstand other NP events considered credible in the DSA where the confinement ventilation system is credited.	If the active confinement ventilation system is not credited for this event there is no need to evaluate that performance and/or design attribute for the confinement ventilation system (discretionary). Also, any impact on the confinement ventilation system performance will be based on the current NP analysis in the DSA.	DOE O 420.1B DOE-HDBK-1169 (9.2)
	As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per 2004-2 Ventilation System Evaluation Guidance Addendum, March 6, 2007, Caution 4 and Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Page 23 Discussion, the evaluation of other NPH events is only required if the accident analysis takes credit for the active confinement ventilation system during or after the NPH event.	

Evaluation Criteria	Discussion	Reference
	7 - Range Fires / Dust Storms	
7.1 Administrative controls should be established to protect confinement ventilation systems from barrier threatening events.	Ensure appropriately thought out response to external threat is defined (e.g. pre-fire plan).	DOE O 420.1B
	The Savannah River Forestry Department is responsible for fire fighting efforts in regards to wildland fires. They also have a program of controlled burns and mechanical thinning of underbrush to limit or prevent wildland fires spreading out of control. If the fire encroaches upon SRNL, the Savannah River Site Fire Department will direct extinguishing efforts. Building 773-A has a current Fire Pre Plan and has procedures to reduce confinement ventilation system air flow (originally develop for electrical system maintenance) that will minimize soot loading of the filters in the ventilation systems. Reference: AOP-06-007 Dust storms are not an issue at the Savannah River Site due to the regional climate. <u>Gap Analysis</u> No Gap. Administrative controls are sufficient to protect the confinement ventilation systems for barrier threatening events.	

Evaluation Criteria	Discussion	Reference
8 - Testability		
8.1 Design supports the periodic inspection and testing of filters and housing, and test and inspections are conducted periodically.	Ability to test for leakage per intent of N510. All four hoods are filtered by a common, testable, stainless steel Flanders HEPA filter housing (nominal cross-section 4'x4') that is located on the Section E lower roof. The housing contains (4) 24" x 24" HEPA filters in a 2-wide x 2-high configuration, a prefilter, and test connections for in-place aerosol leak testing. Although designed and installed for low level radiological & chemical service, both labs have always operated as non-radiological laboratories (WSRC-SA-2, Rev. 3, Section 2.4.1.6). <u>Gap Analysis</u> No Gap.	DOE-HDBK-1169 (2.3.8) ASME AG-1 ASME N510
8.2 Instrumentation required to support system operability is calibrated.	Credited instrumentation should have specified calibration / surveillance requirements. Non-safety instrumentation should be calibrated as necessary to support system functionality. No instrumentation is installed on the F-LHEX system. <u>Gap Analysis:</u> No Gap. If non-safety instrumentation is added to close other gaps, it will be calibrated as needed.	DOE-HDBK-1169 (2.3.8)
8.3 Integrated system performance testing is specified and performed.	Required responses assumed in the accident analysis must be periodically confirmed including any time constraints. An integrated test is not performed nor necessary for current use of the labs. The HEPA filters are leak tested on a routine basis. Evaluation criteria is not applicable. The F-LHEX system is not credited in the SRNL DSA. The labs were originally intended, designed, and built (1980's) for low-level radiation work within its four fume hoods. Although designed and installed for low level radiological & chemical service, both labs have always operated as non-radiological laboratories (WSRC-SA-2, Rev. 3, Section 2.4.1.6). <u>Gap Analysis</u> No Gap.	DOE-HDBK-1169 (2.3.8)

Evaluation Criteria	Discussion	Reference
9 - Maintenance		
9.1 Filter service life program should be established.	Filter life (shelf life, service life, total life) expectancy should be determined. Consider: filter environment, maximum delta-P, radiological loading, age, and potential chemical exposure.	DOE-HDBK-1169 (3.1 & App C)
	Per requirements of SRS Engineering Standard 15888, a Filter service life program has been established for this system. This standard is the basis of the Nuclear Air Cleaning Handbook Appendix C. The filters have a maximum shelf life of 3 years and total life of 10 years. Program is tracked using the Computerized Maintenance Management System . Filter environment is considered. Air drawn into the F-LHEX system is ambient temperature indoor conditioned air with a relative humidity ~ 50%. Therefore moisture accumulation that will adversely affect the filter media is not expected and has not been previously encountered. Gap Analysis No Gap	

Evaluation Criteria	Discussion	Reference
10 - Single Failure		
10.1 Failure of one component (equipment or control) shall not affect continuous operation.	Address potential failures (example failures - fan, backup power supply, switchgear). The F-LHEX system is not credited in the DSA with a preventive or mitigative function following a design basis accident. The system is functionally classified as General Service (GS). Disabling of the system by a single failure of one system component would have no adverse effect offsite or to the co-located worker. Although designed and installed for low level radiological & chemical service, both labs have always operated as non-radiological laboratories (WSRC-SA-2, Rev. 3, Section 2.4.1.6). While the exhaust system is provided with redundant fans, the system is not equipped with any automatic controls to start the standby fan in the event of a failure or provide indication to the control room that the standby fan be manually started. Also the exhaust fans are power from the same motor control center <u>Gap Analysis:</u> Gap Number 48: Discretionary Gap - Failure of online fan does not automatically start the Standby fan. Gap Number 49: Discretionary Gap - Fans are provided standby power from the same Motor Control Center.	DOE O 420.1B (Facility Safety, Chapter I, Sec. 3.b(8))
10.2 Automatic backup electrical power shall be provided to all critical instruments and equipment required to operate and monitor the confinement ventilation system.	[DOE Guidance Document does not provide any specific evaluation guidance discussion for this criteria] The exhaust system is with standby power from MCC-29. No radioactive work is performed in the laboratory. The make-up air system for the laboratory space is not provided with standby power. The main exhaust system (F Process Hood Exhaust System) maintains this portion of facility at a negative pressure to the environment in the event that the Local Hood Exhaust System is not operational <u>Gap Analysis:</u> No Gaps	DOE-HDBK-1169 (2.2.7)
10.3 Backup electrical power shall be provided to all critical instruments and equipment required to operate and monitor the confinement ventilation system.	NOTE: Safety Class is addressed through previous line. This evaluation criteria is NOT APPLICABLE, as it is an SS-only criteria. SRNL confinement ventilation systems are evaluated to SC criteria.	DOE-HDBK-1169 (2.2.7)

Evaluation Criteria	Discussion	Reference
11 - Other Credited Functional Requirements		
11.1 Address any specific functional requirements for the confinement ventilation system (beyond the scope of those above) credited in the DSA.	[DOE Guidance Document does not provide any specific evaluation guidance discussion for this criteria]	10 CFR 830, Subpart B
	Not Applicable.	

Evaluation Criteria	Discussion	Reference
0 - Ventilation System Description & References		
0.1 System Description	N/A System Description Section F is equipped with two 100% outside air, HVAC supply air handling units (AHUs) that provide once-through conditioned air to office areas, corridors, and operating areas on the main and service floors. Each F-HVAC unit is independently ducted to supply one side of Section F main and service floors as shown on facility design drawings. A system crossover damper is provided such that one fan supplies the entire F-section if the other fan is inoperable. The amount of air exhausted from tertiary and secondary zones (with low hazard potential) is greater than the amount of supply air to ensure positive airflow from offices, corridors, service corridors and operating areas with a greater potential for radiological contamination. Reference Attachment 11 Figure B for a system single line. An Auxiliary HVAC Supply Air system supplies filtered and conditioned makeup air (nominal 2,400 cfm) to the face of the four chemical hoods in Dual Lab Module (F-101/F-107). This air supplements the main F-wing supply. The building shell, walls and roof associated with the HVAC system are qualified to PC-1.	N/A

Evaluation Criteria	Discussion	Reference
0.2 System References	N/A	N/A
	System Design Descriptions o M-SYD-A-00023 Rev. 3, F-Section Supply & Exhaust Systems 773-A, System Design Description o T-CLC-A-00011, F Wing Fragility Analysis o M-SYD-A-00024, IA, PLTA & Compressor Alternate CW o E-SYD-A-00008, 773-A D/G Standby Power System Test procedures o TP-02-773A-FWING-02, 773-A, F Wing Air Balance Report o 5Q1.2, Procedure 484, Building Air Survey o TO-05-027, 773-A D/G Annual Design Load Test Round Sheets and Other Procedures o ROD-OPS-2002-002 - Control Area Operator (CAO) Round Sheets o ROD-OPS-2002-003 - Facility Operator (FO) Round Sheets o AOP-06-007, Wildland Fire, Facility Ventilation Shutdown and/or Evacuation Standards o DuPont Engineering Specifications 3027, 3017, 5998, 7591, 8728, H16J, SH1A. o SRS Procurement Specification M-SPP-G-00243, HEPA Filter Specification o SRS Engineering Standard 15888, HEPA Filter Requirements o DOE-STD-3020-2005, DOE Technical Standard - Specification for HEPA Filters Used by DOE Contractors o DOE-STD-3025-2007, DOE Technical Standard - Quality Assurance Inspection and Testing of HEPA Filters o UL 586, UL Standard for Safety, High Efficiency, Particulate, Air Filter Units, 1996 o ANSI/ASME NQA-1, Quality Assurance Program Requirements for Nuclear Facilities Miscellaneous o Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, January 2006 o 2004-2 Ventilation System Evaluation Guidance Addendum, March 2007 o SRNL-ROE-2007-00063, SRNL Table 4-3 Submittal to DOE-SR, April 2007 o WSRC-SA-2, SRNL Technical Area (TA) Documented Safety Analysis (DSA), Revision 3 o WSRC-TS-97-00014, SRNL Technical Area (TA) Technical Safety Requirements (TSRs), Revision 4 o SRNL-ESD-2007-00017, Structural Integrity Program Scope, Resources & Estimate, February 2007	

	Evaluation Criteria	Discussion	Reference
	1 - Ventilation System – General Criteria		
1.1	Pressure differential should be maintained between zones and atmosphere.	Number of zones as credited by accident analysis to control hazardous material release; demonstrate by use considering potential in-leakage. The amount of air exhausted from tertiary and secondary confinement zones is greater than the amount of supply air to ensure positive airflow from offices, corridors, service corridors to operating areas and radiological enclosures with a greater potential for radiological contamination. The F-Section exhaust as measured during the most recent air balance procedure is 35,000 CFM. The F-HVAC (supply) measured flow is 18,200 CFM. A robust air flow from tertiary to secondary to primary confinement zones is maintained. GAP Analysis No Gap	DOE-HDBK-1169 (2.2.9) ASHRAE Design Guide
1.2	Materials of construction should be appropriate for normal, abnormal and accident conditions.	[DOE Guidance Document does not provide any specific evaluation guidance discussion for this criteria] The two HVAC Supply units, located on the east roof of Section F, provide conditioned air to office, corridor and operating areas. One unit serves the east side of Section F while the other unit serves the west side. These supply units utilize building steam for heating and chilled water for cooling. The supply units operate with 100% outside air intake. The F-HVAC fans are housed within the AHU and are made of carbon steel. Outside controls are housed in weather proof enclosures. The flexible connection between the AHU and the Section F HVAC supply ductwork is fabric, non--burning neoprene with glued joints, per DuPont STD H16J. Supply ductwork is made of galvanized carbon steel per DuPont STD H1J and was fabricated and installed per SRS specification 4431. Flanged ductwork joints are one piece full face 1/8" thick neoprene. GAP Analysis: No Gap. Materials of construction are appropriate for normal, abnormal and accident conditions.	DOE-HDBK-1169 (2.2.5) ASME AG-1
1.3	Exhaust system should withstand anticipated normal, abnormal and accident system conditions and maintain confinement integrity.	As required by accident analysis to prevent accident release. The system evaluated is a supply (not exhaust) system. See the appropriate exhaust systems for Section F (Attachments 6 and 7) for evaluation of this criteria. Gap Analysis No Gap	DOE-HDBK-1169 (2.4) ASHRAE Design Guide
1.4	Confinement ventilation systems shall have appropriate filtration to minimize release.	Address: 1) Type of filter (e.g., HEPA, sand, sintered metal); 2) Filter sizing (flow capacity and pressure drop); 3) Decontamination Factor vs. accident analysis assumptions. The Section F HVAC system performs no filtration function to minimize release. See F-PHEX and F-LHEX systems. Gap Analysis No Gap	ASME AG-1 DOE-HDBK-1169 (2.2.1)

Evaluation Criteria	Discussion	Reference
2 - Ventilation System – Instrumentation & Control		
2.1 Provide system status instrumentation and/or alarms.	Address key information to ensure system operability (e.g., system delta-P, filter pressure drop).	ASME AG-1 DOE-HDBK-1169 ASHRAE Design Guide (Section 4)
	Indication of F-HVAC operation status and alarms are provided on Control Room Console Cabinet #1 located in room C-041 (manned continuously). The indicator lamps are illuminated when the Section F HVAC fans are running. The F-Wing Ventilation Control Panel, located in room F-090, provides a digital display for the two (2) supply fan discharge plenum pressures. Local supply fan discharge pressure gauges are also available. The Ventilation Trouble alarm annunciates when the HVAC supply pressure is low. GAP Analysis: No Gap. System status and monitoring features in the F-HVAC supply system are adequate.	
2.2 Interlock supply and exhaust fans to prevent positive pressure differential.	[DOE Guidance Document does not provide any specific evaluation guidance discussion for this criteria]	DOE HDBK 1169 ASHRAE Design Guide (Section 4)
	The F-section supply and exhaust fans are interlocked to prevent a positive pressure differential. The F-section supply fans are controlled by the F-PHEX fans such that the lead supply fan will not start unless the exhaust fan plenum static pressure is below - 3 in. wc. The second supply fan will not start unless the exhaust fan inlet plenum static pressure is below -5 in. wc. Gap Analysis No Gap	
2.3 Post accident indication of filter break-through.	Instrumentation supports post accident planning and response; should be considered critical instrumentation for SC.	TECH-34
	This evaluation criteria is not applicable for any of the supply fans being evaluated for Section F. See evaluation sections for F-PHEX and F-LHEX that discuss the exhaust systems in Section F. The F-HVAC supply air system, Double Lab Module Supply Unit, and F-081 Airlock Supply Unit are not exhaust systems and do not contain HEPA filters that are used to minimize exhaust releases. Gap Analysis No Gap	
2.4 Reliability of control system to maintain confinement function under normal, abnormal and accident conditions.	Address, for example, impacts of potential common mode failures from events that would require active confinement function.	DOE-HDBK-1169 (2.4)
	Not applicable. The fans are not credited in a confinement function, but serve to provide conditioned outside air to the facility. Gap Analysis No Gap	

Evaluation Criteria	Discussion	Reference
2.5 Control components should fail safe.	[DOE Guidance Document does not provide any specific evaluation guidance discussion for this criteria] The F-HVAC supply fans fail in a safe condition. The fans are not credited in a confinement function, but serve to provide conditioned outside air to the facility. <u>Gap Analysis</u> No Gap	DOE-HDBK-1169 (2.4)

Evaluation Criteria	Discussion	Reference
	3 - Resistance to Internal Events – Fire	
3.1 Confinement ventilation systems should withstand credible fire events and be available to operate and maintain confinement.	Required for new facilities; as required by the accident analysis for existing facilities (discretionary). Must address protection of filter media.	DOE-HDBK-1169 (10.1) DOE-STD-1066
	As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Page 21 and 22 Discussion, the evaluation of internal fire events for an existing facility is only required if the accident analysis takes credit for the active confinement ventilation system.	
3.2 Confinement ventilation systems should not propagate spread of fire.	Required for new facilities; as required by the accident analysis for existing facilities (discretionary). Address fire barriers, fire dampers arrangement.	DOE-HDBK-1169 (10.1) DOE-STD-1066
	As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Page 21 and 22 Discussion, the evaluation of internal fire events for an existing facility is only required if the accident analysis takes credit for the active confinement ventilation system.	

Evaluation Criteria	Discussion	Reference
4 - Resistance to External Events – Natural Phenomena – Seismic		
4.1 Confinement ventilation systems should safely withstand earthquakes.	If the active CVS system is not credited in a seismic accident condition there is no need to evaluate that performance and/or design attribute for the confinement ventilation system (discretionary). Also, any seismic impact on the confinement ventilation system performance will be based on the current functional requirements in the DSA. NOTE: Seismic requirements may apply to Defense-in-Depth items indirectly for the protection of safety SSCs. As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per 2004-2 Ventilation System Evaluation Guidance Addendum, March 6, 2007, Caution 4 and Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Page 22 Discussion, the evaluation of seismic events is only required if the accident analysis takes credit for the active confinement ventilation system during or after the NPH event.	ASME AG-1 (AA) DOE O 420.1B DOE-HDBK-1169 (9.2)

Evaluation Criteria	Discussion	Reference
	5 - Resistance to External Events – Natural Phenomena – Tornado/Wind	
5.1 Confinement ventilation systems should safely withstand tornado depressurization.	If the active CVS is not credited in a tornado condition there is no need to evaluate that performance and/or design attribute for the confinement ventilation system (discretionary). Also, any tornado impact on the confinement ventilation system performance will be based on the current functional requirements in the DSA.	DOE O 420.1B DOE-HDBK-1169 (9.2)
	As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per 2004-2 Ventilation System Evaluation Guidance Addendum, March 6, 2007, Caution 4 and Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Pages 22 and 23 Discussion, the evaluation of tornado and wind events is only required if the accident analysis takes credit for the active confinement ventilation system during or after the NPH event.	
5.2 Confinement ventilation systems should withstand design wind effects on system performance.	If the active CVS is not credited in a wind condition there is no need to evaluate that performance and/or design attribute for the confinement ventilation system (discretionary). Also, any wind impact on the confinement ventilation system performance will be based on the current NP analysis in the DSA.	DOE O 420.1B DOE-HDBK-1169 (9.2)
	As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per 2004-2 Ventilation System Evaluation Guidance Addendum, March 6, 2007, Caution 4 and Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Pages 22 and 23 Discussion, the evaluation of tornado and wind events is only required if the accident analysis takes credit for the active confinement ventilation system during or after the NPH event.	

	Evaluation Criteria	Discussion	Reference
		6 - Other NP Events (eg. flooding, precipitation)	
6.1	Confinement ventilation system should withstand other NP events considered credible in the DSA where the confinement ventilation system is credited.	If the active confinement ventilation system is not credited for this event there is no need to evaluate that performance and/or design attribute for the confinement ventilation system (discretionary). Also, any impact on the confinement ventilation system performance will be based on the current NP analysis in the DSA. As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per 2004-2 Ventilation System Evaluation Guidance Addendum, March 6, 2007, Caution 4 and Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Page 23 Discussion, the evaluation of other NPH events is only required if the accident analysis takes credit for the active confinement ventilation system during or after the NPH event.	DOE O 420.1B DOE-HDBK-1169 (9.2)

	Evaluation Criteria	Discussion	Reference
	7 - Range Fires / Dust Storms		
7.1	Administrative controls should be established to protect confinement ventilation systems from barrier threatening events.	Ensure appropriately thought out response to external threat is defined (e.g. pre-fire plan).	DOE O 420.1B
		The Savannah River Forestry Department is responsible for fire fighting efforts in regards to wildland fires. They also have a program of controlled burns and mechanical thinning of underbrush to limit or prevent wildland fires spreading out of control. If the fire encroaches upon SRNL, the Savannah River Site Fire Department will direct extinguishing efforts. Building 773-A has a current Fire Pre Plan and has procedures to reduce confinement ventilation system air flow (originally develop for electrical system maintenance) that will minimize soot loading of the filters in the ventilation systems. Reference: AOP-06-007 Dust storms are not an issue at the Savannah River Site due to the regional climate. <u>Gap Analysis</u> No Gap. Administrative controls are sufficient to protect the confinement ventilation systems for barrier threatening events.	

	Evaluation Criteria	Discussion	Reference
		8 - Testability	
8.1	Design supports the periodic inspection and testing of filters and housing, and test and inspections are conducted periodically.	Ability to test for leakage per intent of N510. Not Applicable. The F-HVAC system has no HEPA filters to be tested. Gap Analysis No Gap	DOE-HDBK-1169 (2.3.8) ASME AG-1 ASME N510
8.2	Instrumentation required to support system operability is calibrated.	Credited instrumentation should have specified calibration / surveillance requirements. Non-safety instrumentation should be calibrated as necessary to support system functionality. The F-HVAC system has no credited instrumentation. Therefore specified calibration / surveillance activities are not required. System instrumentation is calibrated as necessary to support system functionality: when the instrument is installed. Pressure indicators used for facility rounds are calibrated on a periodic basis (ex., transmitters are on a three year calibration cycle in the Computerized Maintenance Management System. Gap Analysis No Gap.	DOE-HDBK-1169 (2.3.8)
8.3	Integrated system performance testing is specified and performed.	Required responses assumed in the accident analysis must be periodically confirmed including any time constraints. The F-HVAC system is not credited in the DSA accident analysis. Testing per the guidelines of ASME N510 is not relevant. Measurements of fan operating features, i.e. CFM capacity, static pressure, and RPM's, are recorded during the periodic F-section air balance activities. In addition, testing of the F supply fan/exhaust fan interlock is performed on a periodic basis as part of the integrated testing of the B and C Central Hood Exhaust Diversion Fan control system. Gap Analysis No Gap.	DOE-HDBK-1169 (2.3.8)

Evaluation Criteria	Discussion	Reference
9 - Maintenance		
9.1 Filter service life program should be established.	Filter life (shelf life, service life, total life) expectancy should be determined. Consider: filter environment, maximum delta-P, radiological loading, age, and potential chemical exposure. Not applicable. The F-HVAC system has no HEPA filters installed. Supply air filters are changed as needed as part of a preventive maintenance program. Gap Analysis No Gap.	DOE-HDBK-1169 (3.1 & App C)

Evaluation Criteria	Discussion	Reference
10 - Single Failure		
10.1 Failure of one component (equipment or control) shall not affect continuous operation.	Address potential failures (example failures - fan, backup power supply, switchgear). Failure of one F-HVAC Fan opens the bypass damper immediately downstream of the AHUs resulting in reduced airflow to each side of Section F. Both F-HVAC fans have alternate backup power (standby DG) which allows continued use of both fans if the normal power switchgear is lost. Each fan is normally powered from a different MCC (MCC-21E & MCC-22E). Failure of F-HVAC control circuitry, instrumentation, components, or the instrument air system that powers the inlet dampers could diminish supply air flow to Section F. Loss of both F-HVAC supply fans would decrease the static pressure in the area, until the F-PHEX automatic static pressure control system reduced the exhaust flow to partially balance the lack of supply air. Local magnehelic gauges are available at the plenums if there is a loss of digital supply and exhaust plenum pressures on the Section F Ventilation Control Panel. Double Lab Module (F-101/F-107) Auxiliary Supply Fan: Failure of the fan, associated switchgear, control circuitry and components would render the supply system inoperable. Operations would suspend use of the four chemical hoods for activities that require auxiliary supply air until operational readiness is reestablished. It should be noted that current use of the labs does not require the supply fan and it is in standby. <u>Gap Analysis</u> No Gap.	DOE O 420.1B (Facility Safety, Chapter I, Sec. 3.b(8))
10.2 Automatic backup electrical power shall be provided to all critical instruments and equipment required to operate and monitor the confinement ventilation system.	[DOE Guidance Document does not provide any specific evaluation guidance discussion for this criteria] The F-HVAC system is not a critical, credited part of the facility safety basis. There is are no associated instruments or equipment required to operate and monitor the confinement ventilation system. The supply units are provided with automatic backup power from the 773-A Standby Diesel Generator, however. <u>Gap Analysis</u> No Gap.	DOE-HDBK-1169 (2.2.7)
10.3 Backup electrical power shall be provided to all critical instruments and equipment required to operate and monitor the confinement ventilation system.	NOTE: Safety Class is addressed through previous line. This evaluation criteria is NOT APPLICABLE, as it is an SS-only criteria. SRNL confinement ventilation systems are evaluated to SC criteria.	DOE-HDBK-1169 (2.2.7)

Evaluation Criteria	Discussion	Reference
11 - Other Credited Functional Requirements		
11.1 Address any specific functional requirements for the confinement ventilation system (beyond the scope of those above) credited in the DSA.	[DOE Guidance Document does not provide any specific evaluation guidance discussion for this criteria] None	10 CFR 830, Subpart B

Evaluation Criteria	Discussion	Reference
0 - Ventilation System Description & References		
0.1 System Description	N/A	N/A

System Description

The SRNL Area Sand Filter (Buildings 794-A, 792-A and 791-A), provides for final treatment and discharge to the atmosphere of potentially contaminated ventilation exhaust serving Sections B, C, E & F of Building 773-A. All exhaust is HEPA filtered (from one to three stages) prior to reaching the sand filter. The sand filter serves as a backup system to minimize atmospheric releases of radioactive particulates in the event of HEPA filter failure. Reference Attachment 11 Figure C for a system single line.

The sand filter is maintained at a negative pressure relative to its surroundings by two large blowers (Building 792-A) located just east of Building 794-A. The normal sand filter exhaust plenum pressure is 7 inwc vac. These blowers are in service to provide continuous exhaust through the Sand Filter. Operation of the Sand Filter is designed for continuous service. One fan is normally operating in the Run position while the alternate fan is in the Standby position. The fan in the Standby position will start when the Sand Filter exhaust plenum pressure drops to 1 inwc vac. The Sand Filter is also equipped with standby power (600 kW diesel generator) and radiological monitoring and sampling systems. The Sand Filter is equipped with a back pressure relief damper which provides an auxiliary passage for sand-filtered exhaust and protects the Sand Filter inlet ductwork from over pressurization.

The Sand Filter discharges to a 100 foot stack (Building 791-A).

The Sand Filter has no structural qualification on file. A cursory review, indicates that the intent was to design the Sand Filter itself (794-A, 792-A and 791-A) to meet PC-2 NPH Criteria. The limiting NPH qualification factors for the Sand Filter system are: 1) The inlet ductwork on the roof of 773-A is support by building framing in Sections E and F qualified to PC-1 and 2) the inlet ductwork on the roof of 773-A (Sections B, C, E and F) is not missile protected.

Evaluation Criteria	Discussion	Reference
0.2 System References	N/A	N/A
	System Design Descriptions o G-SYD-A-00002, SRNL Area Sand Filter System o E-SYD-A-00001, SRNL Stack Monitoring Systems o M-SYD-A-00024, IA, PLTA & Compressor Alternate CW o E-SYD-A-00007, 794-A D/G Standby Power System Drawings o ST5-18755 o M-M6-A-0065 o W236483 o W447446 o W447512 o W447570 Test Procedures o TO-06-012, Functional Test Sand Filter Exhaust System Low Pressure Interlock o TO-06-016, Functional Test of Sand Filter Exhaust System Fans o TE-37-001, Annual Calibration of Eberline Monitors for 773-A B, C and Sand Filter Stacks o TE-37-004, Monthly Source Checking SRNL ALPHA-6A-1 Duct Monitors o TE-37-008, Source Checking the Eberline Monitors for 773-A B, C and Sand Filter Stacks o TO-05-023, 794-A D/G Annual Design Load Test o 5Q1.2, Procedure 484, Building Air Survey o TO-05-027, 773-A D/G Annual Design Load Test Round Sheets and Other Procedures o ROD-OPS-2002-002 - Control Area Operator (CAO) Round Sheets o ROD-OPS-2002-003 - Facility Operator (FO) Round Sheets o AOP-06-007, Wildland Fire, Facility Ventilation Shutdown and/or Evacuation o 2Y1/401 - Technical Reference Procedure for A & B Area, Appendix 51 o TM-75-003, Equipment Lubrication, Attachment 5 Standards o DuPont Engineering Specifications 3027, 3017, 5998, 7591, 8728, H16J, SH1A. o SRS Procurement Specification M-SPP-G-00243, HEPA Filter Specification o SRS Engineering Standard 15888, HEPA Filter Requirements o DOE-STD-3020-2005, DOE Technical Standard - Specification for HEPA Filters Used by DOE Contractors o DOE-STD-3025-2007, DOE Technical Standard - Quality Assurance Inspection and Testing of HEPA Filters o UL 586, UL Standard for Safety, High Efficiency, Particulate, Air Filter Units, 1996 o ANSI/ASME NQA-1, Quality Assurance Program Requirements for Nuclear Facilities Miscellaneous o Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, January 2006 o 2004-2 Ventilation System Evaluation Guidance Addendum, March 2007 o SRNL-ROE-2007-00063, SRNL Table 4-3 Submittal to DOE-SR, April 2007	

Evaluation Criteria	Discussion	Reference
	o WSRC-SA-2, SRNL Technical Area (TA) Documented Safety Analysis (DSA), Revision 3 o WSRC-TS-97-00014, SRNL Technical Area (TA) Technical Safety Requirements (TSRs), Revision 4 o SRNL-ESD-2007-00017, Structural Integrity Program Scope, Resources & Estimate, February 2007 o EOP-06-001, Loss of Both Sand Filter Exhaust System Fans	

Evaluation Criteria	Discussion	Reference
1 - Ventilation System – General Criteria		
1.1 Pressure differential should be maintained between zones and atmosphere.	Number of zones as credited by accident analysis to control hazardous material release; demonstrate by use considering potential in-leakage. Confinement Zones Since the Fan Housing Sand Filter (FHSF) exhaust system serves as a backup system to the other SRNL confinement systems, refer to the specific system listed below for the identification of its confinement zones and differential pressure requirements. CE - Cell Exhaust (Sec E) CHEX - Central Hood Exhaust (Sec B & C) LHEX - Local Hood Exhaust (Sec E) OGE - Offgas Exhaust (Sec B, F & C) PHEX - Process Hood Exhaust (Sec B, C & F) RREX - Regulated Room Exhaust (Sec E) Gap Analysis No Gap	DOE-HDBK-1169 (2.2.9) ASHRAE Design Guide

Evaluation Criteria	Discussion	Reference
1.2 Materials of construction should be appropriate for normal, abnormal and accident conditions.	[DOE Guidance Document does not provide any specific evaluation guidance discussion for this criteria] Materials of construction for above ground duct are as follows: 1. Stainless steel sheets, Grade S, type 304, No. 1 or 2B finish in accordance with ASTM A240, minimum thickness No. 16 gauge. (DuPont Engr. Spec. No. 3027, 06/21/51) 2. Stainless steel sheets, Grade S, type 304L, No. 1 or 2B finish in accordance with ASTM A240, minimum thickness No. 16 gauge (field welding) and No. 18 gauge (shop welding) . (DuPont Engr Spec No. 7591, 06/3/80) 3. Exhaust ducts constructed in Building 773-A by Project S-1175 in 1972 shall be not less than 20 gauge stainless steel and of welded construction (W236483, gen note 13). 4. All stainless steel duct is welded, gasketed, flanged and bolted. Materials of construction for below ground duct are reinforced concrete pipe or reinforced concrete (W447570, gen note). Materials of construction for the sand filter are reinforced concrete (W447446, gen note). The walls and floor are 16 inches thick and the roof is 10 inch thick supported by 30 inch diameter columns. Materials of construction of the seven layer gravel and sand filter bed in the sand filter are identified in G-SYD-A-00002 (2.2.1) and specified in DuPont Spec 5998. Materials of construction for the exhaust fans are mild steel with corrosion resistant coating (G-SYD-A-00002, 2.2.2). Materials of construction of ducts to and from exhaust fans at the sand filter are galvanized steel, all welded construction (W236483, gen note 14). Material of construction of the exhaust stack is Corten A steel (G-SYD-A-00002, 2.2.5). All materials of construction are appropriate for normal, abnormal and accident conditions. <u>Gap Analysis</u> No Gap - All materials of construction are appropriate for normal, abnormal and accident conditions.	DOE-HDBK-1169 (2.2.5) ASME AG-1

Evaluation Criteria	Discussion	Reference
1.3 Exhaust system should withstand anticipated normal, abnormal and accident system conditions and maintain confinement integrity.	As required by accident analysis to prevent accident release.	DOE-HDBK-1169 (2.4) ASHRAE Design Guide
	Normal Conditions The FHSF Sand Filter exhaust airflow normally contains the following HEPA filtered exhaust systems: BC & F PHEX, B/F & C OGE, B&C VAC, E CE, E RREX, E LHEX, B & C LAD, B & C HAD, AM The FHSF Sand Filter exhaust system consists of ducts (stainless steel, concrete and galvanized steel) downstream of these systems. This exhaust air is filtered in the sand filter by a seven layer stone, gravel and sand bed 7.5 feet thick. Air is continually exhausted from the sand filter by two large blowers (one operating and the other in automatic standby status). A 600 kW emergency diesel generator provides electrical power to the blowers, and radiological monitoring and sampling systems. Exhaust air is discharged to the atmosphere thru a 100 ft. high steel stack. Abnormal Conditions The following systems from Bldg 773-A are HEPA filtered and then exhausted to the sand filter during abnormal conditions: The section B & C diversion controls reroute the CHEX for either B or C section to the area sand filter. This diversion is performed manually under the direction of the Shift Operations Manager (SOM) when either the B or C stack monitoring systems detect radiation above preset levels. Controls located in Room E023 and the C041 Control Room allows the diversion controls to be activated. When a diversion is activated, exhaust air is pulled from the concrete plenum between the CHEX fans, and through a single duct to the roof of either B001 or C001, where the diversion fans are located. The diversion system for both B & C sections consists of two fans. One fan is placed in the lead and the other is in standby. Once activated, the lead fan will energize and the three CHEX fans will de-energize. This results in a reduction in flow from about 60,000 cfm to 20,000 cfm. Various supply units in sections B & C are shut down and one of two exhaust fans serving Section F is also shut down to prevent overloading the sand filter. Automatic dampers are actuated to control diversion flow paths. Standby power is provided to the diversion fans by the 794-A diesel generator. The sand filter is equipped with a 5'-5" square back pressure damper located at the north end of the discharge plenum roof. This damper provides an auxiliary passage for sand-filtered exhaust, and prevents the sand filter from over-pressurization. Accident Conditions The following accident scenarios are considered: o Process Explosion - Unstable Lab Chemical or Accumulation of Process Flammable Gas or VOCs with no consequential fire o Explosion - Glovebox Overpressurization o Explosion - Accumulation of Distributed Flammable Gas with no consequential fire o Drop / Spill Ventilation systems (CHEX, PHEX, OGE, CE, RREX, LHEX) would operate normally to contain accident materials by maintaining proper pressure differentials into the labs. Exhaust flows would be HEPA filtered and discharged to the FHSF Sand Filter, either normally, or in the case of CHEX normal exhaust, following diversion activation for high B or C stack	

Evaluation Criteria	Discussion	Reference
	activity. The FHSF Sand Filter offers desirable defense-in-depth protection. Fire detection systems would alert the C041 Control Room to shut down ventilation systems per procedures. Lab, cell walls, gloveboxes and ductwork would passively contain contaminants upstream from the HEPA filters. <u>Gap Analysis</u> No Gap	
1.4 Confinement ventilation systems shall have appropriate filtration to minimize release.	Address: 1) Type of filter (e.g., HEPA, sand, sintered metal); 2) Filter sizing (flow capacity and pressure drop); 3) Decontamination Factor vs. accident analysis assumptions. Air discharged to the SRNL Area Sand Filter is HEPA filtered at least once before reaching the Sand Filter. The Sand Filter provides an additional/back-up stage of filtration in the event to a HEPA filter failure in Building 773-A. The Sand Filter provides equivalent performance (typical removal efficiency is 99.97%) to the HEPA filtered exhaust systems which discharge to the Sand Filter. This translated to a decontamination factor (DF) of 3333. Decontamination factor has not been considered in the facility DSA. The Sand Filter was designed for an airflow of 74,000 cfm. Normal operating flow range is 62,000 cfm. The Sand Filter bed operates with a differential pressure of approximately 7.0 inches wc. No significant variations in bed differential pressure have been observed that have not correlated to changes in system airflow. <u>Gap Analysis</u> No Gap	ASME AG-1 DOE-HDBK-1169 (2.2.1)

Evaluation Criteria	Discussion	Reference
2 - Ventilation System – Instrumentation & Control		
2.1 Provide system status instrumentation and/or alarms.	Address key information to ensure system operability (e.g., system delta-P, filter pressure drop).	ASME AG-1 DOE-HDBK-1169 ASHRAE Design Guide (Section 4)
	Fan status indications are provided at the fans control station in 792-A and the SRNL control room located in 773-A. Sand Filter Inlet and Outlet (stack) air flow are monitored and recorded on facility round sheets. Low flow conditions alarm in the SRNL control room. Sand Filter Fan inlet plenum pressure is monitored and alarmed in the SRNL control room. Sand Filter Bed differential pressure is monitored and recorded on facility round sheets. Sand Filter Bed inlet sump is monitored for liquids and recorded on facility round sheets. The Sand Filter bed is equipped with localized differential pressure taps to measure differential pressure across different layers and sections of the bed if needed. The Sand Filter bed is equipped to with tubes to permit radiation profiling of the Sand Filter bed if needed. The Sand Filter inlet duct is provided with a continuous monitor to detect excessive alpha and beta-gamma activity being released to the sand filter. The monitors alarm in the SRNL control room if excessive activity is detected. Gap Analysis No Gap	
2.2 Interlock supply and exhaust fans to prevent positive pressure differential.	[DOE Guidance Document does not provide any specific evaluation guidance discussion for this criteria]	DOE-HDBK-1169 ASHRAE Design Guide (Section 4)
	Since the FHSF Sand Filter exhaust system serves as a backup to the other exhaust systems it has no supply fans. Supply fan interlocks will be described in the other systems listed in this table. Gap Analysis No Gap	

Evaluation Criteria	Discussion	Reference
2.3 Post accident indication of filter break-through.	Instrumentation supports post accident planning and response; should be considered critical instrumentation for SC.	TECH-34
	The sand filter stack is equipped with both an isokinetic sampling system for environmental compliance sampling, a stack air activity monitoring system to provide on-line indication in the SRNL control room and a sand filter inlet alpha and beta/gamma monitor which alarm in the SRNL control room. The two systems were installed in the 1990's and the inlet monitors were installed in the 1970's. <u>Gap Analysis</u> No Gap	
2.4 Reliability of control system to maintain confinement function under normal, abnormal and accident conditions.	Address, for example, impacts of potential common mode failures from events that would require active confinement function.	DOE-HDBK-1169 (2.4)
	The FHSF Sand Filter exhaust fans are continuously monitored by Operations personnel. Operation of the systems is controlled by operating procedures. System control is maintained during abnormal and accident conditions by AOPs and EOPs. If the exhaust fan inlet plenum pressure drops below 1 inwc vac, the operating fan automatically stops and the standby fan starts. Upon loss of power the 794-A standby diesel generator starts and restores electrical power. Other abnormal system operating conditions such as the system diversions discussed in Criteria 1.3 are accommodated by interlocks provided for these systems. These interlocks maintain the Sand Filter exhaust flow within normal limits. <u>Gap Analysis</u> No Gap	
2.5 Control components should fail safe.	[DOE Guidance Document does not provide any specific evaluation guidance discussion for this criteria]	DOE-HDBK-1169 (2.4)
	The Sand Filter Fan discharge dampers fail open upon a loss of instrument air or loss of power. This is to prevent over pressurization of the Sand Filter inlet SST ductwork from the 773-A which push air to the Sand Filter. If the exhaust fan control circuit fails and holds both discharge dampers closed, a back pressure relief damper on the Sand Filter bed discharge plenum opens to prevent the same over pressurization event. <u>Gap Analysis</u> No Gap	

Evaluation Criteria	Discussion	Reference
3 - Resistance to Internal Events – Fire		
3.1 Confinement ventilation systems should withstand credible fire events and be available to operate and maintain confinement.	Required for new facilities; as required by the accident analysis for existing facilities (discretionary). Must address protection of filter media.	DOE-HDBK-1169 (10.1) DOE-STD-1066
	As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Page 21 and 22 Discussion, the evaluation of internal fire events for an existing facility is only required if the accident analysis takes credit for the active confinement ventilation system.	
3.2 Confinement ventilation systems should not propagate spread of fire.	Required for new facilities; as required by the accident analysis for existing facilities (discretionary). Address fire barriers, fire dampers arrangement.	DOE-HDBK-1169 (10.1) DOE-STD-1066
	As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Page 21 and 22 Discussion, the evaluation of internal fire events for an existing facility is only required if the accident analysis takes credit for the active confinement ventilation system.	

Evaluation Criteria	Discussion	Reference
4 - Resistance to External Events – Natural Phenomena – Seismic		
4.1 Confinement ventilation systems should safely withstand earthquakes.	If the active CVS system is not credited in a seismic accident condition there is no need to evaluate that performance and/or design attribute for the confinement ventilation system (discretionary). Also, any seismic impact on the confinement ventilation system performance will be based on the current functional requirements in the DSA. NOTE: Seismic requirements may apply to Defense-in-Depth items indirectly for the protection of safety SSCs. As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per 2004-2 Ventilation System Evaluation Guidance Addendum, March 6, 2007, Caution 4 and Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Page 22 Discussion, the evaluation of seismic events is only required if the accident analysis takes credit for the active confinement ventilation system during or after the NPH event.	ASME AG-1 (AA) DOE O 420.1B DOE-HDBK-1169 (9.2)

Evaluation Criteria	Discussion	Reference
5 - Resistance to External Events – Natural Phenomena – Tornado/Wind		
5.1 Confinement ventilation systems should safely withstand tornado depressurization.	If the active CVS is not credited in a tornado condition there is no need to evaluate that performance and/or design attribute for the confinement ventilation system (discretionary). Also, any tornado impact on the confinement ventilation system performance will be based on the current functional requirements in the DSA.	DOE O 420.1B DOE-HDBK-1169 (9.2)
	As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per 2004-2 Ventilation System Evaluation Guidance Addendum, March 6, 2007, Caution 4 and Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Pages 22 and 23 Discussion, the evaluation of tornado and wind events is only required if the accident analysis takes credit for the active confinement ventilation system during or after the NPH event.	
5.2 Confinement ventilation systems should withstand design wind effects on system performance.	If the active CVS is not credited in a wind condition there is no need to evaluate that performance and/or design attribute for the confinement ventilation system (discretionary). Also, any wind impact on the confinement ventilation system performance will be based on the current NP analysis in the DSA.	DOE O 420.1B DOE-HDBK-1169 (9.2)
	As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per 2004-2 Ventilation System Evaluation Guidance Addendum, March 6, 2007, Caution 4 and Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Pages 22 and 23 Discussion, the evaluation of tornado and wind events is only required if the accident analysis takes credit for the active confinement ventilation system during or after the NPH event.	

Evaluation Criteria	Discussion	Reference
6 - Other NP Events (eg. flooding, precipitation)		
6.1 Confinement ventilation system should withstand other NP events considered credible in the DSA where the confinement ventilation system is credited.	If the active confinement ventilation system is not credited for this event there is no need to evaluate that performance and/or design attribute for the confinement ventilation system (discretionary). Also, any impact on the confinement ventilation system performance will be based on the current NP analysis in the DSA.	DOE O 420.1B DOE-HDBK-1169 (9.2)
	As discussed in Table 4-3 transmittal letter SRNL-ROE-2007-00063, Attachment 4, Table 1, this evaluation criteria is NOT APPLICABLE. Per 2004-2 Ventilation System Evaluation Guidance Addendum, March 6, 2007, Caution 4 and Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006, Page 23 Discussion, the evaluation of other NPH events is only required if the accident analysis takes credit for the active confinement ventilation system during or after the NPH event.	

Evaluation Criteria	Discussion	Reference
7 - Range Fires / Dust Storms		
7.1 Administrative controls should be established to protect confinement ventilation systems from barrier threatening events.	Ensure appropriately thought out response to external threat is defined (e.g. pre-fire plan).	DOE O 420.1B
	The Savannah River Forestry Department is responsible for fire fighting efforts in regards to wildland fires. They also have a program of controlled burns and mechanical thinning of underbrush to limit or prevent wildland fires spreading out of control. If the fire encroaches upon SRNL, the Savannah River Site Fire Department will direct extinguishing efforts. Building 773-A has a current Fire Pre Plan and has procedures to reduce confinement ventilation system air flow (originally develop for electrical system maintenance) that will minimize soot loading of the filters in the ventilation systems. Reference: AOP-06-007 Dust storms are not an issue at the Savannah River Site due to the regional climate. <u>Gap Analysis</u> No Gap. Administrative controls are sufficient to protect the confinement ventilation systems for barrier threatening events.	

Evaluation Criteria	Discussion	Reference
8 - Testability		
8.1 Design supports the periodic inspection and testing of filters and housing, and test and inspections are conducted periodically.	Ability to test for leakage per intent of N510. The FHSF Sand Filter has the capabilities for in-place testing. It is Aerosol Efficiency Tested (AET) on an 18 month frequency in accordance with Appendix 51 of 2Y1/401. Aerosol is injected into a duct in Room E095 (Bldg 773-A, Sec E) and the test is conducted at the northeast corner of the FHSF Sand Filter near the fan suction. The surface of the Sand Filter bed was also inspected by Engineering and Operations personnel in August 2004. The Sand Filter was installed 1972 under Project 9S1175 and this was the first and only inspection made since initial installation. Entry to the Sand Filter building (794-A) was made through a wooden air-lock constructed at the back pressure damper located at the north end of the upper sand filter roof. No abnormalities were found. Gap Analysis No Gap	DOE-HDBK-1169 (2.3.8) ASME AG-1 ASME N510
8.2 Instrumentation required to support system operability is calibrated.	Credited instrumentation should have specified calibration / surveillance requirements. Non-safety instrumentation should be calibrated as necessary to support system functionality. The FHSF Sand Filter system has no calibration requirements in the SRNL TSR. FHSF Sand Filter system inlet pressure switches (PS-6504, -6505) and low pressure alarm switch (PAL-6009) on the north and south fans, as well as the plenum pressure gauge (PI-6010), are calibrated on a two year frequency. Other system non-safety instrumentation is calibrated only on an as-needed basis, there is no established calibration frequency. Gap Analysis No Gap	DOE-HDBK-1169 (2.3.8)
8.3 Integrated system performance testing is specified and performed.	Required responses assumed in the accident analysis must be periodically confirmed including any time constraints. The FHSF Sand Filter system functional startup testing is performed after major maintenance events to ensure that interlocks and controls function as designed. Instrument calibrations are verified monthly during FHSF fan functional test and every 18 months during the FHSF fan low suction interlock test. See Section 0.2 (system references) for testing procedures. Gap Analysis No Gap	DOE-HDBK-1169 (2.3.8)

Evaluation Criteria	Discussion	Reference
9 - Maintenance		
9.1 Filter service life program should be established.	Filter life (shelf life, service life, total life) expectancy should be determined. Consider: filter environment, maximum delta-P, radiological loading, age, and potential chemical exposure.	DOE-HDBK-1169 (3.1 & App C)
	Trending of the FHSF Sand Filter differential pressure helps to predict when the service life of a sand filter is nearing its end. However, the service life (about 15 years) of the 294-F and 294-H sand filters (replaced in 1975 and 1976 respectively) was shortened by acid attack of concrete blocks supporting the filter bed over the lateral distribution tunnels. The SRNL Sand Filter was the first filter at SRS designed to resist acid attack. Since 1974 four other sand filters have been put into service with the acid resistant design. This design has lengthened the service life of these sand filters to the point that it is difficult to predict it. However, the SRNL Sand Filter was designed in a manner to facilitate its replacement on the north side of the 794-A sand filter (see W447512). The August 2004 Sand Filter bed inspection discussed in 8.1-TY-1 showed the SRNL Sand Filter to have significant service life remaining. <u>Gap Analysis</u> No Gap	

Evaluation Criteria	Discussion	Reference
10 - Single Failure		
10.1 Failure of one component (equipment or control) shall not affect continuous operation.	Address potential failures (example failures - fan, backup power supply, switchgear).	DOE O 420.1B (Facility Safety, Chapter I, Sec. 3.b(8))
	The FHSF Sand Filter exhaust fans are redundant and are equipped with standby electrical power. Each fan is fed from a separate motor control center. The separate motor control centers are powered from a single normal power substation and a single diesel generator. The normal power substation is provided power feeds from two separate main transformers. Separate control loops are installed for each fan. The Stack Isokinetic Sampling system and the Stack Air Activity Monitoring system are independent from each other. One system will be available to pull a sample from the stack in the event that the other is off-line. Gap Analysis Gap Number 56: Discretionary Gap - Fan MCCs are not distributed across different D/Gs.	
10.2 Automatic backup electrical power shall be provided to all critical instruments and equipment required to operate and monitor the confinement ventilation system.	[DOE Guidance Document does not provide any specific evaluation guidance discussion for this criteria]	DOE-HDBK-1169 (2.2.7)
	In the event of a power failure, the FHSF Sand Filter fans and associated controls are provided standby power by the 792-A diesel generator. The isokinetic sampling system is provided standby power by the 792-A diesel generator. The on-line stack air activity monitoring system electronics are powered by a UPS, but their fans (located in Building 779-A) are not provided with back-up power. Gap Analysis Gap Number 57: Discretionary Gap - Standby power is not provided for the stack air activity monitoring (SAAM) fans.	
10.3 Backup electrical power shall be provided to all critical instruments and equipment required to operate and monitor the confinement ventilation system.	NOTE: Safety Class is addressed through previous line.	DOE-HDBK-1169 (2.2.7)
	This evaluation criteria is NOT APPLICABLE, as it is an SS-only criteria. SRNL confinement ventilation systems are evaluated to SC criteria.	

Evaluation Criteria	Discussion	Reference
11 - Other Credited Functional Requirements		
11.1 Address any specific functional requirements for the confinement ventilation system (beyond the scope of those above) credited in the DSA.	[DOE Guidance Document does not provide any specific evaluation guidance discussion for this criteria]	10 CFR 830, Subpart B
	None <u>Gap Analysis</u> No Gap	

Attachment 8 (Page 1 of 13)

Scope, Estimate and Recommendation for Gap Closure

Gap	Scope/Approach	Estimated Cost	Discussion/Recommendation
1	Install blanks in a total of 11 locations between HEPA filter banks in Sections B/C-CHEX system.	$190K to $290K (Task 16)	Recommend **closing** this gap. The B/C-CHEX HEPA filters are the primary filtration for the two highest dose events (1 & 2). Installation of the blanks will provide improved protection to the facility worker by reducing the spread of contamination within the primary and secondary confinement zone. Also see Gap #5.
2	Add automatic isolation dampers on B/C-HVAC (supply system) fan discharges at 16 locations where multiple fans discharge from a common "wind box".	$3.2M to $5.1M (Task 5)	Concern is that airborne contamination could migrate back through the supply ductwork and be discharged to tertiary confinement zone or other portions of the secondary confinement zone. Recommend **not closing** this gap. Automatic isolation dampers are already provided on the eight primary supply fans for the lab modules (secondary confinement zone) on the main floor. Closing the gap will not mitigate a dose from Low to Negligible for Events 1 and 2. The FET has recommended closing Gaps 1, 3, 4, 5, 6 and 15 as a more effective use of funds.
3	Install hard wire interlocks between B/C-CHEX, B/C-PHEX, and B/C-HVAC systems supply and exhaust fans to prevent positive ΔPs in the secondary and tertiary confinement zones during upset conditions.	$3.9M to $5.7M (Task 5)	Recommend **closing** this gap. If exhaust is lost and supply air is not shutdown, the MAR associated with Events 1, 2 and 5 will be pushed from the secondary confinement zone to the atmosphere.

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Scope, Estimate and Recommendation for Gap Closure

Gap	Scope/Approach	Estimated Cost	Discussion/Recommendation
4	Replace existing tape-in-place HEPA filter housings for B/C CHEX and PHEX (in B/C-005) with new HEPA filter housings. Two options were investigated: Option A replaces the entire filter bank for each of the 64 lab modules with ASME AG-1 compliant redundant HEPA filter housings. Option B replaces the existing 146 tape-in-place housings with ASME AG-1 compliant HEPA filter housing and reuses the existing filter bank inlet and outlet plenums.	Option A: $37M to $57M (Task 1) Option B: $10M to $15M (Task 20)	Each option provides an improved HEPA filter seating and ductwork integrity to permit the system to be credited at the Safety Class functional classification with a Decontamination Factor (DF) of 200. This will reduce the consequences of Events 1, 2, 3 and 5 including mitigating the two Low consequence events to Negligible. Option A provides redundant flow paths to facilitate HEPA filter change-out every seven years. Based on the ability to suspend individual lab operations during filter change-out, the FET does not feel that the additional expenditure of funds is justified when compared to Option B. Option A would require five to seven years to implement. The magnitude of work would impact the ability of SRNL to perform its mission. Option B has already been implemented on a selected basis for some lab modules and could be completed in approximately 3 years. Option B would not adversely impact the ability of SRNL to perform its mission. Recommend **closing** this Gap using Option B.
5	Install blanks in a total of 11 locations between HEPA filter banks in Sections B/C-CHEX system	Cost included in Gap 1	Recommend **closing** this gap. The B/C-CHEX HEPA filters are the primary filtration for events 1 and 2. Installation of the blanks will improve the performance of in-place HEPA filter testing. Also see Gap #1.
6	Provide B/C-CHEX Fan Standby Power separation by moving power feed for one CHEX fan in both Sections B and C to a motor control center that is provided power from the 773-A D/G.	$150K to $250K (Task 6)	Recommend **closing** this gap. Closing this gap will improve reliability of the single most important primary confinement system for 773-A Sections B and C by spreading the fans across four motor control centers and two diesel generators. This will decrease the probability of Events 2 and 5 and increase the probability of mitigating Events 1, 2, 3 and 5.

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Scope, Estimate and Recommendation for Gap Closure

Gap	Scope/Approach	Estimated Cost	Discussion/Recommendation
7	Replace inlet stainless steel (SST) Level 4 ductwork from roof penetration to Diversion fan inlets including isolation dampers and flexible connections.	$1.2M to $1.8M (Task 8)	The new ductwork configuration will eliminate the fan inlet turbulence (system effect) that is impacting fans and diversion system performance and reliability. Recommend **not closing** this gap. While closing the gap will improve the reliability of the CHEX Diversion fan system, the fans will maintain Section B or C secondary confinement zones under negative pressure based on the existing supply and exhaust interlocks and the new interlocks recommended to close Gap 3. Also the probability of this system being needed is low if Gap 4 (B/C-CHEX and PHEX HEPA filter housings) is closed.
8 9 10 11 12	Three options were investigated to close the five gaps associated the Section B/C Changeroom exhaust systems: ***Option A*** would install two (one each for Sections B & C) new exhaust skids with HEPA filtration (Gap 8), isolation dampers, redundant exhaust fans (Gap 11) and alpha stack monitor (Gap 10) connected to automatic backup electrical power (Gap 12) and full instrumentation and control to the control room (Gap 9). ***Option B*** would install two new exhaust skids with HEPA filtration, isolation damper, single fan, normal power, stack sampler and interlock with the primary confinement zone exhaust. ***Option C*** would add a low leak isolation damper on each system and interlock the fan and damper control with the primary confinement zone exhaust.	Option A $3.6M to 5.2M (Task 7) Option B $800K to $1.2M (Task 7) Option C $600K to $900K (Task 7)	Recommend **not closing** the five gaps using any of the three options. The changerooms are located in the tertiary confinement zone. Exhaust from the change room is 2% of the total ventilation for the associated primary, secondary and tertiary confinement zones. If the process events occurred with the primary confinement zone ventilation system operational, approximately 2% of the material (0.04 rem dose to the MOI) would be available for release from this location. The cost to mitigate a Negligible (<0.5 rem) release to the MOI is not justified when compared to advantages of closing Gaps 3, 4, 6 and 15.

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Scope, Estimate and Recommendation for Gap Closure

Gap	Scope/Approach	Estimated Cost	Discussion/Recommendation
13	Provide status instrumentation and control of B/C-HVAC system supply fans in the control room.	$1.2M to $1.7M (Task 14)	The estimate is the incremental cost to close this gap concurrently with closing Gap 3 (interlocks between supply and exhaust systems). If performed as a stand alone task, the cost would be considerable higher. Recommend **not closing** this gap. The primary benefit of preventing over pressurization of secondary and tertiary confinement zone is accomplished by providing interlocks between the supply and exhaust systems (i.e. closing Gap 3 which the FET recommends). Having the ability to verify that a fan has actually shutdown and manual shutdown the fan if the interlock has failed is desirable but does not directly reduce the dose from any of the process events evaluated.
14	Install differential pressure sensors between tertiary confinement zone and atmosphere is Sections B and C and transmit signal to the control room.	$130K to $185K (Task 21)	Recommend **not closing** this gap. Closing Gap 3 (supply/exhaust interlock) will provide the necessary safety function.
15	Provide B/C-PHEX Fan standby power separation by moving power feed for one PHEX fan in both Sections B and C to a motor control center that is provided power from the 773-A D/G.	$150K to $250K (Task 6)	PHEX fans are already cross fed from different MCCs (5E and 6E). Single mode failure goes all the way back to the single Sand Filter D/G. Recommend **closing** this gap. This will improve the reliability of a primary confinement system associated with the Events 1 and 2.
16	Install hardwire interlocks between B/C-RREX Supply and Exhaust fans for B/C-001 equipment rooms and B/C-005 filter rooms.	$300K to $600K (Task 4)	Recommend **not closing** this gap. These systems serve rooms in the secondary confinement zones that do not normally have any MAR and would only mitigate Event 3. The incremental improvement in performance for a Negligible consequence event is not justified by the cost of the modifications.
17	Provide a standby fan for each of the four B/C-RREX systems (Equipment Room & Shielded Area Exhaust systems in Sections B and C) by removing the individual fans for each system and installing a redundant pair of fans sized to handle both systems in a section.	$2.0M to $3.2M (Task 9)	Recommend **not closing** this gap. These systems serve rooms in the secondary confinement zones that do not normally have any MAR and would only mitigate Event 3. The incremental improvement in reliability for a Negligible consequence event is not justified by the cost of the modifications.

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Scope, Estimate and Recommendation for Gap Closure

Gap	Scope/Approach	Estimated Cost	Discussion/Recommendation
18	Provide B/C-RREX Fans automatic back-up power by moving the motor starters from MCC-5 to MCC-5E (2 fans) and from MCC-6 to MCC-6E (2 fans).	\$300K to \$500K (Task 6)	Recommend **not closing** this gap. These systems serve rooms in the secondary confinement zones that do not normally have any MAR and would only mitigate Event 3. The incremental improvement in reliability for a Negligible consequence event is not justified by the cost of the modifications.
19	Provide outlet HEPA filter ΔP instrumentation for 21 OGE gloveboxes that do not have this capability. Local gauge will require installation of half-coupling, SST tubing, isolation valves and gauge bracket.	\$420Kto \$630K (Task 10)	Recommend **not closing** this gap. Glovebox outlet HEPA filter ΔP instrumentation is installed on the majority of facility gloveboxes, but not in all cases. Glovebox outlet HEPA filter is not credited and will not need to be credited to mitigate any of the evaluated events. It would be more effective to provide the glovebox exhaust monitoring instrumentation (Gap 20) since this instrumentation and glovebox differential pressure can be used to determine if the glovebox outlet HEPA filter needs to be replaced due to high differential pressure.
20	Provide glovebox exhaust flow monitoring instrumentation for 26 OGE gloveboxes that do not have this capability.	\$3.4M to \$4.3M (Task 3)	Glovebox exhaust flow rate instrumentation is installed on a number of gloveboxes (typically for the more recent installations) expected to hold Hazard Category 2 quantities of radiological material, but not in all cases. Recommend **closing** this gap. Ensuring adequate glovebox airflow is a key preventer for two of the events including one of the events with Low consequences.
21	Install OGE standby fan autostart interlocks between the existing fan starters for both Section B and C subsystems.	\$100K to \$200K (Task 4)	Operator currently starts standby fan manually from the control room upon receiving a system alarm. Recommend **closing** this gap. Autostart of the standby fan in place of manual startup by the control room operator provides an automatic function that could prevent Event 1.
22	Provide OGE fan standby power separation by moving power feed for one OGE fan in both Sections B and C to a motor control center that is provided power from the 773-A D/G.	\$150K to \$250K (Task 6)	Recommend **closing** this gap. Improved reliability of the system could prevent Event 1 which has the highest dose to the MOI and CW.

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Scope, Estimate and Recommendation for Gap Closure

Gap	Scope/Approach	Estimated Cost	Discussion/Recommendation
23	Replace the six B Cell Block 3rd stage HEPA filters (rated of 1000 each cfm) with HEPA filters rated for 1500 cfm Option A – Change filter model immediately Option B - Replace filter model at next schedule filter replacement	Option A $20K to $25K (Task 17) Option B $2K to $4K (Task 17)	Normal operations is for both banks of three filters to be on-line with a filter capacity of 6000 cfm vs normal operating airflow of 4500 cfm. The only time the filters operate above design airflow is during filter replacement. The HEPA filters are backed up by the Sand Filter. Recommend **closing** this gap at next schedule filter change (Option B). Closing the gap immediately will provide no dose reduction and not improve reliability.
24	Replace the six A Cell Block 2nd and 3rd stage HEPA filters (rated of 1000 each cfm) with HEPA filters rated for 1500 cfm. Option A -- Change filter model immediately Option B – Replace filter model at next schedule filter replacement	Option A $25K to $30K (Task 30) Option B $2K to $4K (Task 30)	Normal operations is for all three single filter banks to be on-line for both the 2nd and 3rd stages. Each stage has a filter capacity of 3000 cfm and normal operating airflow of 3000 cfm. The only time the filters operate above design airflow is during filter replacement. The HEPA filters are backed up by the Sand Filter. Recommend **closing** this gap at next scheduled filter change (Option B). Closing the gap immediately will provide no dose reduction and not improve reliability.
25	Provide ΔP indicators for the eight HEPA filter housings associated with A Cell Block 2nd Stage HEPA filters, A Cell Block 3rd stage HEPA filters and B Cell Block 3rd Stage HEPA filters. Local gauge will require installation of half-coupling, SST tubing, isolation valves and gauge bracket.	$160K to $240K (Task 10)	Recommend **not closing** this gap. In-cell (or first stage) HEPA filters take the vast majority of material loading and are equipped with duct monitors downstream of the filters. The Cell Block 2nd and 3rd stage HEPA filters have never been replaced due to high differential pressure or failed in-place testing. They are replaced every five to seven years based on filter service life. Also, each HEPA filter flow path is equipped with low airflow alarms that would provide an alarm to the control room if filter loading occurred. If both stages of HEPA filtration leak.
26	Install electrical interlock between primary supply and exhaust systems for 773-A Section E (CE, HVAC, RREX, LHEX)	$600K to $1M (Task 18)	Recommend **closing** this gap for the primary confinement systems. Closing this gap will provide the ability to isolate the air supply and keep the primary confinement from being pressurized if the primary exhaust system were to fail during operations or an upset condition by securing the supply fans.

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Scope, Estimate and Recommendation for Gap Closure

Gap	Scope/Approach	Estimated Cost	Discussion/Recommendation
27	Provide standby power separation for the four Cell Exhaust fans and remove the control power for each set of fans from a common transformer by: 1) Installing a new motor control center in Section E feed from the Sand Filter D/G and 2) Moving power feeds for one A Cell Block exhaust fan (MCC 11E) and one B Cell Block exhaust fan (MCC 15E) to the new motor control center	$830K to $1.2M (Tasks 6 & 13)	Recommend **closing** this gap. Improvements to the reliability of both Cell Block exhaust systems will increase the probability of preventing Event 4 and will help mitigate Events 3 and 4.
28 29 30 31 32	Three options were investigated to close the five gaps associated the Section E-HV Men's and Ladies' Changeroom exhaust systems: Option A would install two (one each for men's and one for ladies' changerooms) new exhaust skids with HEPA filtration (Gap 28), isolation dampers, redundant exhaust fans (Gap 31) and alpha stack monitor (Gap 30) all connected to automatic backup electrical power (Gap 32) with full instrumentation and control to the control room (Gap 29). Option B would install two new exhaust skids with HEPA filtration, isolation damper, single fan, normal power and interlock with the primary confinement zone exhaust. Option C would add a low leak isolation damper on the Ladies' changeroom and interlock the fan and damper control with the primary confinement zone exhaust. No modification would be made to the Men's changeroom since it is already HEPA filtered.	Option A $2.6M to 5.2M (Task 7) Option B $800K to $1.2M (Task 7) Option C $300K to $450K (Task 7)	Recommend **not closing** these five gaps using any of the three options. The changerooms are located in the tertiary confinement zone. If an upgrade system was installed, it would mitigate only a portion of Event 3 with the primary or secondary confinement ventilation systems mitigating the majority of the event. The cost to mitigate a negligible (<0.5 rem MOI and <5 rem CW) release is not justified when compared to other cost benefit of closing other gaps such as Gaps 35, 36, 37, 39, 40 and 42.

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Scope, Estimate and Recommendation for Gap Closure

Gap	Scope/Approach	Estimated Cost	Discussion/Recommendation
33	Modify the recirculating HVAC system in the manipulator shop (E-095) by adding a HEPA filter housing and booster fan.	\$215K to \$320K (Task 15)	Recommend **not closing** this gap. The manipulator repair shop is part of the secondary confinement zone due to the potential for contamination on the interior surface of a stripped and externally decontaminated manipulator. There is no MAR in this portion of the secondary confinement zones and none of the evaluated events are postulated to occur in this space. The cost to mitigate a negligible release is not justified when compared to other cost benefit of closing other gaps such as Gaps 35, 36, 37, 39, 40 and 42.
34	Provide fan status and control for the three (3) E-HVAC supply fans in 773-A Section E (EP 20984, EP 20922 and EN 812-500) to the 773-A Control Room using the remote I/O Rack in 773-A Section E	\$600K to \$1000K (Task 31)	Recommend **not closing** this gap. Interlocks between supply and exhaust system (Gap 26 which the FET recommends closing) will mitigate dose from the events. The additional scope needed to close this gap will have no direct dose reduction.
35 36 37 39 40 42	Complete Project Y189 which consolidates five LHEX and RREX systems in Section E into one RREX system. This will replace several tape-in-place HEPA filter housings (Gaps 36 & 42), replace several HEPA filters that are currently operating at greater than their rated airflow (Gaps 35 and 38), provide redundant fans (Gap 37) and provide HEPA filter differential pressure instrumentation (Gap 40).	\$2.0M to \$2.3M (Task 22)	Project Y189 has been funded through design and procurement of engineering equipment. Estimate range provided is an Estimate to Complete that does not include costs to date and does include OPEX to support start-up, procedures and training for the new system. Recommend **closing** the gap by completing Project Y189. Closing the gaps would provide improved performance and reliability for the secondary confinement zone exhaust system where Event 3 is most likely to occur. Closure of this gap will provide better mitigation of a release than closing Gaps 28 thru 33.
38	Provide standby power to the new exhaust system being installed under project Y189 to replace three existing E-RREX systems and two E-LHEX systems. See Gaps 35, 36, 37, 39, 40 and 42.	\$75K to \$250K (Task 6)	Closure of the gap would be at lower end of cost range if Gap 27 is closed. Recommend **closing** the gap. Closing the gap would provide improved reliability for the secondary confinement zone exhaust system where Event 3 is most likely to occur. The gap should be closed concurrent with closure of Gaps 35, 36, 37, 39, 40 and 42 to provide a replacement secondary confinement system.
39	See Gap 35	Cost included in Gap 35	Recommend **closing** the gap
40	See Gap 35	Cost included in Gap 35	Recommend **closing** the gap

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Scope, Estimate and Recommendation for Gap Closure

Gap	Scope/Approach	Estimated Cost	Discussion/Recommendation
41	Provide local and control room fan instrumentation and alarms for the E-RREX Fan Room Exhaust sub-system using the remote I/O Rack in 773-A Section E	$250K to $300K (Task 24)	The fan rooms were originally used for the first generation A and B Cell Block exhaust system first stage HEPA filter housings and exhaust fans. These systems were replaced in the mid 1970s. The majority of equipment has been removed but the rooms remain contaminated and part of the secondary confinement zone. Recommend **not closing** this gap. The rooms in the secondary confinement zone associated with this system have no Material at Risk.
42	See Gap 35	Cost included in Gap 35	Recommend **closing** the gap
43	Add a standby fan for the E-RREX Fan Room Exhaust sub-system by replacing existing fan with a skid equipped with redundant fans.	$350K to $500K (Task 25)	The fan rooms were originally used for the first generation A and B Cell Block exhaust system first stage HEPA filter housings and exhaust fans. These systems were replaced in the mid 1970s. The majority of equipment has been removed but the rooms remain contaminated and part of the secondary confinement zone. Recommend **not closing** this gap. The rooms in the secondary confinement zone associated with this system have no Material at Risk.
44	Provide standby power to the following E-RREX sub-systems: High Bay Exhaust, Lab & Storage Exhaust and Fan Room Exhaust. Fan Room Exhaust (subtask 1) would be connect the existing fan to MCC 11E. High Bay Exhaust and Lab & Storage Exhaust (subtask 2) completed as part of closing Gap 38.	Subtask 1 $150K to $300K (Task 6) Subtask 2 $0K (see gap 38)	The fan rooms were originally used for the first generation A and B Cell Block exhaust system first stage HEPA filter housings and exhaust fans. These systems were replaced in the mid 1970s. The majority of equipment has been removed but the rooms remain contaminated and part of the secondary confinement zone. Recommend **not closing** this gap. The rooms in the secondary confinement zone associated with this Fan Room exhaust system have no Material at Risk. The High Bay Exhaust and Lab & Storage Exhaust portion of the gap is already recommended to be closed as part of Gap 38.

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Scope, Estimate and Recommendation for Gap Closure

Gap	Scope/Approach	Estimated Cost	Discussion/Recommendation
45	Provide a single ΔP indication for HEPA Filter Housing in the F-LHEX system. Local gauge will require installation of half-coupling, SST tubing, isolation valves and gauge bracket.	$20K to $30K (Task 10)	This laboratory space is only used for chemical work and from a radiological confinement stand-point the space is part of the tertiary confinement zone. If the exhaust fans fails, an existing interlock will turnoff the supply fan for the space so there is no impact on the performance of the primary, secondary or tertiary confinement zones. Recommend **not closing** this gap.
46	Provide system instrumentation and alarms for the F-LHEX system by using the remote I/O Rack in 773-A Section E	$100K to $200K (Task 26)	This laboratory space is only used for chemical work and from a radiological confinement stand-point the space is part of the tertiary confinement zone. If the exhaust fans fails, an existing interlock will turnoff the supply fan for the space so there is no impact on the performance of the primary, secondary or tertiary confinement zones. Recommend **not closing** this gap. Since the system will not mitigate any of the evaluated events, adding system instrumentation and alarms is not justified.
47	Two scopes were evaluated for closing this task: Option A – Restore abandoned stack sampler to operation and relocate sampler box to a location where it can be safely accessed during an event. Option B – Provide an on-line alpha stack monitor to the control room.	Option A $90K to $135K (Task 27) Option B $1.0M to $1.5M (Task 27)	The F-LHEX laboratory space served by this stack is only used for chemical work and from a radiological confinement stand-point is part of the tertiary confinement zone. Recommend **not closing** this gap. Only Event 3 has the potential to provide any MAR to this stack. The consequences from this event are Negligible without mitigation and the small fraction of the MAR that reached this system would be HEPA filtered. No type of radiological sampling or monitoring for this stack is justified.
48	Install standby fan autostart by interconnecting the fan start circuits with the system alarms added by closing Gap 46 and adding automatic inlet isolation dampers to the fans.	$600K to $1.0M (Task 4)	This laboratory space is only used for chemical work and from a radiological confinement stand-point the space is part of the tertiary confinement zone. If the exhaust fans fails, an existing interlock will turnoff the supply fan for the space so there is no impact on the performance of the primary, secondary or tertiary confinement zones. Recommend **not closing** this gap. Since the system will not mitigate any of the evaluated events, the increase in fan/airflow reliability is not justified.

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Scope, Estimate and Recommendation for Gap Closure

Gap	Scope/Approach	Estimated Cost	Discussion/Recommendation
49	Move power for one of the two F-LHEX fans serving F-101/107 to MCC-21E or 22E to spread the power feed across two MCCs and two D/Gs.	$150K to $250K (Task 6)	This laboratory space is only used for chemical work and from a radiological confinement stand-point the space is part of the tertiary confinement zone. If the exhaust fans fails, an existing interlock will turnoff the supply fan for the space so there is no impact on the performance of the primary, secondary or tertiary confinement zones. Recommend **not closing** this gap. Since the system will not mitigate any of the evaluated events, the increase in power system reliability is not justified.
50	Provide differential pressure instrumentation for both CPF Cells 1 thru 3 and MSF Cells 1 thru 5 by removing spare KAPL plugs and installing new KAPL plugs with sensing tubes connected to differential pressure indicators.	$35K to $65K (Task 28)	Both sets of cells have been deinventoried and are inactive per the DSA. The SRNL Infrastructure plan states that cells will be D&D'ed and D&D planning has been initiated. Recommend **not closing** this gap. Based on the current status and future plans for the cells, the FET recommends that gap not be closed.
51	Provide glovebox outlet HEPA filter ΔP instrumentation for the four F-PHEX system gloveboxes located in F-151. Local gauge will require installation of half-coupling, SST tubing, isolation valves and gauge bracket.	$80K to $120K (Task 10)	The four gloveboxes are part of the SED facility and are inactive per the DSA. The SRNL Infrastructure plan states that cells will be D&D'ed and D&D planning has been initiated. Recommend **not closing** this gap. Based on the type events evaluated for Section F, sudden changes in HEPA filter differential pressure are unlikely. Routine glovebox differential pressure readings provide adequate indication of system performance.
52	Install differential pressure monitoring instrumentation for the 37 HEPA filter housings associated with the F-PHEX system. Local gauge will require installation of half-coupling, SST tubing, isolation valves and gauge bracket.	$740K to $1.1M (Task 10)	The majority of the filter housings are for inactive facilities per the DSA. The SRNL Infrastructure plan states these facilities will be D&D'ed. D&D planning has been initiated. Recommend **not closing** this gap. Based on the types of operations performed and events evaluated for Section F, sudden changes in HEPA filter differential pressure are unlikely. Routine system airflow readings and airflow directional surveys provide adequate indication of system performance.

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Scope, Estimate and Recommendation for Gap Closure

Gap	Scope/Approach	Estimated Cost	Discussion/Recommendation
53	Replace exhaust fan inlet damper actuators with actuators that will fail-safe in the closed position and will have a hand wheel for manual operation.	$70K to $110K (Task 11)	The current damper actuators are double air actuated and fail in the as left condition. Due to the type of actuator currently installed, the dampers will move to a half closed position and can not be manually positioned to the full open or closed position without a full maintenance crew. Recommend **closing** this gap. This will improved the reliability of the primary confinement system that prevents or mitigates Events 1, 2, 3 and 5.
54	Replace the tape-in-place outlet HEPA filter housings for the Medical Source Facility with traditional bag-in/bag-out HEPA filter housings	$180K to $240K (Task 23)	Recommend **not closing** this gap. None of the evaluated events can occur in the Medical Source Facility since it has been de-inventoried and is inactive per the DSA. The SRNL Infrastructure plan states that cells will be D&D'ed and D&D planning has been initiated.
55	Improve F PHEX Fan standby power reliability by moving the power feed from fan #3 starter from MCC-22E to MCC-23E which is powered from a different D/G.	$75M to $125K (Task 6)	Three PHEX fans are fed from MCC-21E and 22E which are powered from 773-A D/G. Moving one PHEX fan to MCC-23E which is powered by the Sand Filter D/G removes the common mode failure. Recommend **closing** this gap. The F-PHEX system prevents or mitigates Events 1, 2, 3 and 5.
56	Provide separate automatic diesel generator feeds for the Sand Filter exhaust fans by installing a new PC-1 600 KW diesel generator system and a set of switch gear for one fan and keeping the other fan on the existing Sand Filter 600 KW diesel generator.	$650K to $1.3M (Task 29)	Based on the size of the Sand Filter fan motors (150 HP), they can not be provided automatic standby power from one of the other two D/Gs (773-A D/G @ 455 KW or 503-2A D/G @ 400KW) in the SRNL Technical Area. Recommend **closing** this gap. Operation of the sand filter fans is essential to ensure the proper operation of the B/C/F-OGE, B/C-PHEX. E-CE, E-RREX, E-LHEX and F-PHEX systems. These six systems prevent or mitigate all five of events.

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Scope, Estimate and Recommendation for Gap Closure

Gap	Scope/Approach	Estimated Cost	Discussion/Recommendation
57	For the Sand Filter stack air activity monitoring (SAAM) fans, provided standby power from the Sand Filter D/G.	$500K to $750K (Task 12)	Two alternatives were considered to close the gap, providing automatic D/G power to the existing SAAM fans at 779-A or installing new dedicated SAAM fans connected to the D/G at the Sand Filter stack. They are both bounded by the cost range provided. The new fans would be in the lower end of the initial cost range but have a higher life cycle cost due to the additional components that would need to be maintained. All air to the Sand Filter is HEPA filtered before being discharged to the Sand Filter inlet duct. The Sand Filter inlet is monitored by a monitoring system that is provided with standby power. The Sand Filter stack is equipped with a sampling system that is provided standby power. Only the stack monitoring system to the control room would be impacted upon a loss of normal power. Recommend **not closing** this gap. The SAAM system does not prevent or directly mitigate any of the five events. For the system to indirectly mitigate any of the events, three simultaneous events/failures (process event that damages HEPA filtration, failure of normal power and break through of the sand filter bed) need to occur to obtain any benefit.
58	Rewire both the A and B Cell Block exhaust system controls to support fans being supplied power from multiple motor control centers.	$390K to $550K Task 19	Recommend to Close Gap

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Cross-Walk of Gaps Recommended for Closure that would Reduce the Probability and/or Consequences of Events Evaluated

Event #1: **Explosion – Glovebox Overpressurization**
Locations: **B, C and F**
Unmitigated Dose: **CW 9.6 rem, MOI 1.9 rem**

Sections	Prevent	Mitigate
B/C	Gap 20 – Add glovebox flow instrumentation Gap 21- Add OGE standby fan auto start Gaps 22 and 56 - Improve reliability of exhaust fans (OGE and FHSF) by spreading standby power across two D/Gs	Gap 3 - Interlock between supply and exhaust (CHEX, PHEX, HVAC) Gap 4 – Improve reliability of primary/secondary confinement exhaust (CHEX and PHEX) HEPA filtration Gaps 6, 15 and 56 - Improve reliability of exhaust fans (CHEX, PHEX and FHSF) by spreading standby power across two D/Gs
F	Gap 20 – Add glovebox flow instrumentation Gap 21- Add OGE standby fan auto start capability Gaps 22 and 56 - Improve reliability of exhaust fans (OGE and FHSF) by spreading standby power across two D/Gs	Gap 53 - Improve reliability of exhaust fans (PHEX) by changing failure mode of fan inlet dampers Gaps 55 and 56 - Improve reliability of exhaust fans (PHEX and FHSF) by spreading standby power across two D/Gs

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Cross-Walk of Gaps Recommended for Closure that would Reduce the Probability and/or Consequences of Events Evaluated

Event #2: **Explosion – Accumulation of Distributed Flammable Gas with no consequential fire**
Locations: **B, C and F**
Unmitigated Dose: **CW 8.57 rem, MOI 1.68 rem**

Sections	Prevent	Mitigate
B/C	Gap 6 - Improve reliability of exhaust fans (CHEX) by spreading standby power across two D/Gs	Gap 3 - Interlock between supply and exhaust (CHEX, PHEX, HVAC) Gap 4 - Improve reliability of primary/secondary confinement exhaust (CHEX and PHEX) HEPA filtration Gaps 6, 15 and 56 - Improve reliability of exhaust fans (CHEX, PHEX and FHSF) by spreading standby power across two D/Gs
F	Gap 53 - Improve reliability of exhaust fans (PHEX) by correcting failure mode of fan inlet dampers Gaps 55 and 56 - Improve reliability of exhaust fans (PHEX and FHSF) by spreading standby power across two D/Gs	Gap 53 - Improve reliability of exhaust fans (PHEX) by correcting failure mode of fan inlet dampers Gaps 55 and 56 - Improve reliability of exhaust fans (PHEX and FHSF) by spreading standby power across two D/Gs

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Cross-Walk of Gaps Recommended for Closure that would Reduce the Probability and/or Consequences of Events Evaluated

Event #3: Drop / Spill
Locations: B, C, E and F
Unmitigated Dose: CW 1.5 rem, MOI 0.31 rem

Sections	Prevent	Mitigate
B/C	None	Gap 3 - Interlock between supply and exhaust (CHEX, PHEX and HVAC) Gap 4 - Improve reliability of primary/secondary confinement exhaust (CHEX and PHEX) HEPA filtration Gaps 6, 15 and 56 - Improve reliability of exhaust fans (CHEX, PHEX and FHSF) by spreading standby power across two D/Gs
E	None	Gap 26 - Interlock between supply and exhaust (CE, LHEX, RREX and HVAC) Gap 27 – Improve reliability of exhaust fans (CE) by spreading standby power across two D/Gs. Gap 58 – Improve reliability of exhaust fans (CE) by providing independent control transformers Gaps 35, 36, 37, 38, 39, 40 and 42 – Improve performance and reliability of the secondary confinement zone exhaust systems (LHEX and RREX)
F	None	Gap 53 - Improve reliability of exhaust fans (PHEX) by correcting failure mode of fan inlet dampers Gaps 55 and 56 - Improve reliability of exhaust fans (PHEX and FHSF) by spreading standby power across two D/Gs

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Cross-Walk of Gaps Recommended for Closure that would Reduce the Probability and/or Consequences of Events Evaluated

Event #4: **Process Explosion – Unstable Lab Chemical or Accumulation of Process Flammable Gas or VOCs with no consequential fire**
Location: **E**
Unmitigated Dose: **CW 1.5 rem, MOI 0.31 rem**

Sections	Prevent	Mitigate
E	Gap 27 – Improve reliability of exhaust fans (CE) by spreading standby power across two D/Gs Gap 56 - Improve reliability of exhaust fans (FHSF) by spreading standby power across two D/Gs Gap 58 – Improve reliability of exhaust fans (CE) by providing independent control transformer	Gap 26 - Interlock between supply and exhaust (CE, LHEX, RREX and HVAC) Gap 27 – Improve reliability of exhaust fans (CE) by spreading standby power across two D/Gs Gap 56 - Improve reliability of exhaust fans (FHSF) by spreading standby power across two D/Gs Gap 58 – Improve reliability of exhaust fans (CE) by providing independent control transformer

Attachment 9 (Page 5 of 5)

Cross-Walk of Gaps Recommended for Closure that would Reduce the Probability and/or Consequences of Events Evaluated

Event #5: **Process Explosion – Unstable Lab Chemical or Accumulation of Process Flammable Gas or VOCs with no consequential fire**
Locations: **B, C and F**
Unmitigated Dose: **CW 1.1 rem, MOI 0.21 rem**

Sections	Prevent	Mitigate
B/C	Gap 20 – Add glovebox airflow instrumentation Gap 21- Add OGE standby fan auto start capability Gaps 6, 15, 22 and 56 - Improve reliability of exhaust fans (CHEX, PHEX, OGE & FHSF) by spreading standby power across two D/Gs	Gap 1 – Minimize spread of contamination between lab modules (CHEX) Gap 3 - Interlock between Supply and Exhaust (CHEX, PHEX and HVAC) Gap 4 - Improve reliability of primary/secondary confinement exhaust (CHEX and PHEX) HEPA filtration Gaps 6, 15 and 56 - Improve reliability of exhaust fans (CHEX, PHEX & FHSF) by spreading standby power across two D/Gs
F	Gap 20 – Add glovebox airflow instrumentation Gap 21- Add OGE standby fan auto start capability Gap 53 - Improve reliability of exhaust fans (PHEX) by failure mode of fan inlet dampers Gaps 55 and 56 - Improve reliability of exhaust fans (PHEX and FHSF) by spreading standby power across two D/Gs	Gap 53 - Improve reliability of exhaust fans (PHEX) by correcting failure mode of fan inlet dampers Gaps 55 and 56 - Improve reliability of exhaust fans (PHEX and FHSF) by spreading standby power across two D/Gs

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FET Composition & Biographical Sketches

J. Scott MacMurray – WSRC SRNL FET Lead

Scott MacMurray is a Principal Engineer with WSRC and serves as the Chair of the WSRC Ventilation and Filtration Technical Committee and as a member of the DNFSB 2004-2 Site Evaluation Team.

Mr. MacMurray has 20 years of experience at the Savannah River Site in the areas of Design, Facility Engineering, Safety Documentation, Operations, Maintenance and Environmental Compliance in assignments at SRNL, B Area and F Area. Prior responsibilities included serving as the WSRC HEPA Filter Testing Cognizant Technical Function, Project Design Authority for replacement of various Safety Significant Ventilation Systems at SRNL, Project Design Authority for the Regulatory Monitoring and Bioassay Laboratory, SRNL Design Authority Engineering Group Lead, SRNL Operations Manager, SRNL Control Room Supervisor and SRNL Shift Technical Engineer.

Prior to SRS, Mr. MacMurray had 3 years of chemical laboratory facility engineering experience. He is a Corresponding Member of ASHRAE Technical Committees 9.10 Laboratory Systems, 9.2 Industrial Air Conditioning and 9.2 Nuclear Subcommittee. He holds a BS degree in Mechanical Engineering from Drexel University.

John A. Smartt – DOE Safety System Oversite

John Smartt is a nuclear engineer with DOE Savannah River Operations Office in the Nuclear Material Engineering Division. He currently leads DOE review and assessment teams for all SRNL safety basis changes and issues, and authors Safety Evaluation Reports to document the basis for DOE approval. He formerly served as DOE Alternate Site Lead and Safety Basis Representative on the DNFSB 2004-2 Site Evaluation Team.

Mr. Smartt has 16 years of nuclear facility safety experience at the Savannah River Site including work in contractor oversight from both site and facility perspectives, in complex-wide and site-wide policy and procedure formation, and in field implementation assessment.

Prior to DOE, Mr. Smartt had 8 years of commercial nuclear power experience working at Tennessee Valley Authority's Sequoyah Nuclear Plant, writing and performing startup and post-modification tests and executing system engineering duties. He holds a BS degree in Engineering, specializing in Electrical Instrumentation and Controls, from the University of Tennessee at Chattanooga.

Attachment 10 (Page 2 of 5)

FET Composition & Biographical Sketches

Charles H. Neill, Jr. – WSRC

Charlie Neill is a Principal Engineer with WSRC in the Savannah River National Laboratory (SRNL) Facility Engineering group. He is currently the lead Design Authority Engineer (DAE) for several key process ventilation systems. He has been a SRNL DAE for 14 years, specializing in all aspects of fume hoods, HEPA filters, air balance and configuration management. He is currently on the Site WSRC Ventilation and Filtration Technical Committee.

Mr. Neill has 25 years of experience at the Savannah River Site (SRS) in the areas of Facility, Systems and Power Engineering. He has worked in the Reactor buildings and Powerhouses in P, L, K and C Areas, in addition to his current assignment in the SRNL. Besides having worked extensively on a computer code to model the cooling water feed system, reaching from the Savannah River and Par Pond pumphouses to the reactor area storage basins, Charlie was the Lead System Engineer on a backup system to the control computer reactor monitoring and shutdown system that injected a gadolinium (reactor poison) solution into the reactor core.

Prior to SRS, Mr. Neill spent time at DuPont's Florence (SC) Mylar plant where he played a major role in the startup of two 70,000 pph pulverized coal-fired boilers, DuPont's Kinston (NC) Dacron plant where he worked in the R&D group to improve yarn uniformity, including one patent investigation for spun-like Dacron yarn and Houston (TX) Fluor Engineers and Constructors office specializing in insulation and coatings in their Piping Department for Saudi Arabian gas and oil separation plants.

Mr. Neill has his Engineer in Training (EIT) certificates from both Alabama and Texas. Charlie has a BSME from Auburn University (AU) where he specialized in the thermal sciences and a MSME from North Carolina State University (NCSU) where he specialized in solar storage.

Marcus L. Lowe – WSRC

Mark Lowe is a Principal Engineer with the SRNL Design Authority group. He has lead DA responsibility for several process areas for the SRNL facility including process ventilation systems. He has been a laboratory systems DA engineer for 12 years.

Earlier Mr. Lowe served for 6 years at SRS as a mechanical discipline design engineer for Bechtel Savannah River, Inc. (BSRI) in the Engineering & Projects Division for Reactor Division projects and laboratory small projects.

Prior to SRS service, Mr. Lowe was assigned for 14 years as an engineer in the commercial nuclear power industry at three nuclear power plants. Duties included construction engineer, startup engineer and maintenance engineer. Mr. Lowe is a registered professional engineer (Inactive) in the state of Mississippi. Mark has a BS degree from the U.S. Coast Guard Academy.

Attachment 10 (Page 3 of 5)

FET Composition & Biographical Sketches

Roger M. White – WSRC

Roger White is a Principal Engineer in the Engineering & Technology department of the Soil & Groundwater Closure Projects organization. He is currently the Design Authority for several Waste Sites in the A/M-Area of SRS supporting ongoing remedial activities as well as developing new remedial applications through the established RCRA and CERCLA documentation processes.

Mr. White has 15 years of experience at the Savannah River Site in areas of research, design, testing, and operation of site utilities and environmental remediation technologies. Mr. White has served as a Liaison Engineer in Site Utilities and as an Environmental Engineer in the Savannah River Technology Center (now SRNL) and in Soil & Groundwater Closure Projects. Mr. White has been a key contributor to the successful development and application of airlift recirculation well technology at SRS and in the expansion of active and passive soil vapor extraction technologies.

Prior to working at SRS, Mr. White spent 20 years in private industry as a mechanical and process engineer designing and installing production equipment and processes. Functions included research and development, corporate engineering in support of a network of nationwide manufacturing facilities, and plant engineering at specific locations. He has a B.S. degree in Mechanical Engineering from the Pennsylvania State University, an M.E. degree in Environmental Engineering from the University of South Carolina, and an M.B.A. from Augusta State University. Mr. White is a registered professional engineer in the state of Georgia.

John R. Schaber - WSRC

John Schaber is a Principal Engineer with WSRC who has worked in the Nonproliferation Technology Group at SRNL since mid October 2006. Previously, he worked as an Export Control and High Risk Reviewer for the WSRC Asset Management Group for six years. Other assignments at SRS have included such positions as a Project DA engineer and as a project manager for F&H Area nuclear facilities responsible for implementing numerous process upgrades and engineered equipment replacements. During this period, he served as the FA01 design SME for two years evaluating project compliance and assigning self-assessments for Separations Engineering. He also held positions of technical and process engineer for FB-Line during facility restart.

Mr. Schaber has nearly 19 years experience at the Savannah River Site with extensive technical and field experience in fabrication of engineered process equipment with tight dimensional tolerances, remote technology, cranes, switchgears, piping and chilled water systems, ventilation & containment modifications, installation and testing at SRS nuclear facilities. He served five years as a commissioned officer in the USN Nuclear Propulsion Program and has a B.Sc. degree in Chemical & Petroleum Refining Engineering from the Colorado School of Mines.

Attachment 10 (Page 4 of 5)

FET Composition & Biographical Sketches

Srikant Mehta - WSMS

Srikant Mehta is currently a Project Manager with Washington Safety Management Solutions, LLC. In this role he is responsible for the management of a Documented Safety Analysis Upgrade project for Washington TRU Solutions, LLC, and the Final Safety Analysis Report development for the Combined Operating License Application for two Luminant (a division of TXU Corporation) nuclear power plants (Comanche Peak units 3 & 4). In addition to his project responsibilities, he serves as a member of the DNFSB 2004-2 Facility Evaluation Team for SRNL at SRS.

Mr. Mehta, has over 20 years of project management and nuclear safety experience at commercial nuclear power plants and DOE materials production/waste management and disposal facilities at SRS. His expertise spans through the areas of project management, DSA/FSAR development and management, regulatory/licensing programs, safety analysis (transient and severe accident), Integrated Safety Management implementation, safety-in-design implementation, and operations support. Recent assignments completed by Mr. Mehta include the Advanced Fuel Cycle Facility, the Modern Pit Facility, 3013 Container Storage and Surveillance Capability project, and multiple Liquid Radioactive Waste treatment facilities/projects.

Mr. Mehta holds a PMP certification from the Project Management Institute in addition to a Masters degree in Nuclear Engineering from Iowa State University, and, a Bachelors degree in Metallurgical Engineering from the Indian Institute of Technology, Kanpur, India.

Jerry A. Clements - WSMS

Jerry Clements is a nuclear engineering consultant with ACTS of SC, Inc., on assignment to SRNL/Research Operations Department/Laboratory Services Engineering as the Lead Engineer for SRNL Safety Documentation.

Mr. Clements has 16 years of experience in the commercial nuclear industry and another 17 years experience at the Savannah River Site in the areas of design, engineering, safety analysis and environmental compliance. At SRNL, Mr. Clements has had assignments as the Bechtel Savannah River, Inc. (BSRI) Chief Nuclear Engineer, the BSRI Project Engineer for SRNL Division Managed Modifications, and (for the past 11 years) the Lead Engineer for SRNL Safety Documentation. Prior Bechtel assignments included Design Project Engineer for the TVA Browns Ferry No. 2 Restart, Project Engineer/Project Manager (Acting) for Engineering Support to Commonwealth Edison Company nuclear projects, and Nuclear Systems Supervisor for design support to Consumers Power Company nuclear projects.

Mr. Clements represents SRNL on the SRS Authorization Basis Steering Committee, the Unreviewed Safety Question (USQ) Working Group, and the Nuclear Criticality Safety Review Committee. He is also a member of the SRNL Facility Operations Safety Committee and the Criticality / Accountability Review Committee.

Attachment 10 (Page 5 of 5)

FET Composition & Biographical Sketches

B. Ronald (Ron) Moncrief – WSRC

Ron Moncrief is Senior Technical Advisor in the M&O Engineering organization. He is currently is an SRS subject matter expert for H&V and Sand filters. He serves as Vice Chairman of the SRS Ventilation and Filtration Technical Committee and contributed to the development of SRS Standard 15889, Confinement Ventilation Systems Design Criteria.

Mr. Moncrief has over 40 years of engineering experience at SRS. His experience includes mechanical design, project management and all aspects of H&V engineering.

Mr. Moncrief has a Bachelor of Mechanical Engineering form the Georgia Institute of Technology. He also serves as Secretary and voting member of the Nuclear Subcommittee of the Industrial Air Conditioning Technical Committee TC 9.2 in the American Society of Heating Refrigeration and Air Conditioning Engineers (ASHRAE) and contributed to the ASHRAE publication, HVAC Design Guide for DOE Nuclear Facilities. He also serves as Secretary of the Instruments and Measurement Technical Committee TC 1.2 in ASHRAE.

Robert Gschwendner – WSRC

Robert Gschwendner is a Senior QA Engineer A in the Technical and Quality Services department of the WSRC Liquid Waste Organization. He currently serves as a Quality Engineer for the Receiving Inspection Group and as the WSRC Level III QC Inspector Certifying Authority for the Mechanical discipline.

Mr. Gschwendner has 19 years of experience at the Savannah River Site in the areas of Quality Assurance, Quality Control, and oversight of Maintenance, Operations, Engineering and Waste Certification activities. Prior facility assignments include P, L and K Reactors, H Tank Farm, Spent Fuel Programs, RBOF, H Canyon and HB Line. Prior responsibilities include serving as facility Quality Engineer and FOSC QA representative for various facilities, serving as Spent Fuel Programs Alternate Technology Program DOE/RW-0333P QA Program Engineer, and performing QA reviews and oversight of design, construction and startup activities for various projects at K Reactor, H Tank Farm and H Canyon, including the HEU Blenddown Project.

Prior to working at SRS, Mr. Gschwendner served for 7 years in the US Navy Nuclear Submarine program. His various assignments included serving as ship's Reactor Refueling Officer, qualification as Ship's Engineering Officer and serving as a Staff Instructor and Maintenance Officer at a Nuclear Prototype Training Unit. Mr. Gschwendner has a BS degree in Engineering Science from the State University of New York (SUNY) at Stony Brook.

SEPARATION

PAGE

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United States Government **Department of Energy (DOE)**

memorandum

Savannah River Operations Office (SR)

DATE: NOV 2 1 2007

REPLY TO ATTN OF: TSD (Mark A. Smith, 803-952-9613)

SUBJECT: Request for Concurrence with Recommendation of the Defense Nuclear Facilities Safety Board (DNFSB) 2004-2 Final Report for the Savannah River Site (SRS) F & H Area Analytical Laboratory

TO: Dae Y. Chung, Deputy Assistant Secretary for Safety Management and Operations (EM-60), HQ

In accordance with the DNFSB 2004-2 Implementation Plan (IP) Deliverable 8.6.5, please find attached to this memorandum the DNFSB 2004-2 Final Report for the SRS F & H Area Analytical Laboratory. After completing the evaluation, eight discretionary gaps were identified. None of the gaps were driven by consequences to the public which were shown to be well below the DOE Evaluation Guidelines. SRS recommends that four of these gaps be closed to increase system reliability and operational benefits. The gaps recommended for closure could be closed at an estimated cost ranging between $3.73M to $7.46M. The gaps are:

- Pressure instrumentation is not available to monitor pressure differential between the building interior and outside environment
- Replace existing relay cabinet with a programmable logic controller (PLC) to increase system reliability
- Ventilation component controls do not fail safe, the controls are not SS and are not credited. Replacement of the existing relay cabinet with a PLC will close this gap
- Backup power cables between the lab and the diesel generator could be more robust

It is recommended that the four remaining gaps not be closed because their closure does not provide incremental benefit or significant risk reduction.

Facility modifications to close the recommended gaps will be included in the H-Area and Support Groups Infrastructure Plan and will be prioritized against other facility and site needs.

In accordance with IP deliverable 8.6.5, please provide Program Secretarial Officer concurrence with this recommendation within 90 days of receipt of this report.

If you have any questions, please contact Mark A. Smith at 803-952-9613.

Jeffrey M. Allison
Manager

TSD:MAS:dmy

OSQA-08-0013

Attachment:
2004-2 Final Report for F & H Area
Analytical Laboratory

cc w/attachment:
Dr. Robert C. Nelson (EM-61), HQ
Percy Fountain (EM-3.2), HQ

NOV 2 : 2007

SRS SITE EVALUATION TEAM CONCURRENCE
Final DNFSB 2004-2 Evaluation Report

Facility: **F & H Area Analytical Laboratory.** WSRC Letter M&O-FHO-2007-00054, "772-F, F & H Area Laboratories, DNFSB 2004-2 Active Confinement Evaluation (Final Report)", dated 6/20/07

Reference:

1. Commitment 8.6.3 of DNFSB 2004-2 Implementation Plan Revision 1, dated July 12, 2006

2. Ventilation System Evaluation Guidance for Safety-Related and Non-Safety-Related Systems, dated July 2006, Revision 1.

In accordance with the references above, the SRS Site Evaluation Team has reviewed and concurs with the submittal of the attached F & H Area Analytical Laboratory final report.

Site Evaluation Team (SET) Concurrence:

Signature on file — 10/25/07
Mark A. Smith, DOE-SR, Site Lead for SET — Date

Signature on file — 10/25/07
Ken W. Stephens, WSRC Lead for SET — Date

SRS Site Evaluation Team consists of the following personnel:

DOE Site Lead and SET Chairman (Mark A. Smith, OSQA/TSD)
DOE Alternate Site Lead & Safety Basis SME (Don J. Blake, AMWDP/WDED)
DOE Ventilation System and Natural Phenomena Hazards SME (Brent J. Gutierrez, AMWDP/WDED)
WSRC 2004-2 Site Lead Ken W. Stephens (TQS/Nuclear Safety, Transportation, and Engineering Standards Dept. Mgr.)
WSRC Alternate Site Lead & Safety Basis SME (Andrew M. Vincent, M&O Chief Engineer Dept.)
WSRC Ventilation System SME (Scott J. MacMurray, SRNL Facility Engineering)
WSMS Safety Basis SME (Jerry L. Hansen)
WSRC SET Assistant Project Manager (Barbara A. Pollard, Nuclear Safety Dept.)

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JUN 2 0 2007

M&O-FHO-2007-00054
RSM Track # 10067

Carl A. Everatt, Director
Office of Safety and Quality Assurance
DOE, Savannah River Operations Office
P.O. Box A
Aiken, S.C. 29802

Dear Mr. Everatt:

Subject: 772-F, F & H Area Laboratories,
DNFSB 2004-2 Active Confinement Evaluation (Final Report)

This letter transmits the final report of DNFSB Recommendation 2004-2, Active Confinement Systems for the 772-F Facility located at the Savannah River Site (SRS) for Site Evaluation Team (SET) and Independent Review Panel (IRP) review and concurrence. The attached report has been generated in accordance with the guidance provided in "Ventilation System Evaluation Guidance for Safety-Related and Non-Safety-Related Systems," Revision 0, January 2006. The facility Evaluation Team (FET) has concurred with the information contained herein.

The 772-F building is a Hazard Category 2 nuclear facility. The active components of the confinement ventilation systems for 772-F are housed in 772-F and 772-4F, a neighboring building defined as a Radiological Facility. This report provides a discussion of the events within the 772-F facility that have the potential for a radiological release that were used as the foundation for Table 5.1, Ventilation System Performance Criteria reviews. Events which act only upon 772-4F were excluded from discussion due to the limited inventory which will normally be carried in the HEPA filters.

In accordance with the DOE 2004-2 Ventilation System Evaluation Guidance, SRS evaluated the confinement ventilation systems at 772-F and components housed in 772-4F using Safety Significant (SS) criteria for the events listed in Table 4.3 in order to develop DNFSB 2004-2 Ventilation Performance Criteria, Table 5.1. Using the SS criteria for evaluating Table 5.1, Performance Category 2 and 3 design load criteria were used to assess the facility for applicable NPH events. Eight gaps were identified between the SS criteria and the 772-F and 772-4F designs. All eight gaps were found to be discretionary in nature since none of the gaps involved a discrepancy between the Safety Basis requirements and the facility designs. In reviewing the discretionary gaps, a number of approaches were developed and evaluated for potential means of closure. None of the modifications/upgrades listed as gap closures were perceived as resulting in a discernable reduction in material release reducing the overall risk for any of the bounding accidents in the DSA. If some or all of the discretionary gaps are closed there is perceived benefit in increased system reliability. Increased system reliability by its nature translates into a discernable reduction in accident risk. The FET recommends the closure of four of the gaps should the DOE decide to fund efforts related to system enhancements for improving worker protection.

Facility Evaluation Team Concurrence:

Billy Hudson, DOE, Nuclear Materials Engineering Division — 6/20/07 Date

Timothy H. Gabriel, FHLAB 2004-2 Lead — 6/20/07 Date

Sincerely,

Michael L. Willis, F-Area Chief Engineer — 6/20/07

CC:

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Brent J. Gutierrez, 707-H
Andrew M. Vincent, 703-H
J. Scott MacMurray, 773-43A
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M&O-FHO-2007-00054
Revision 0

Savannah River Site
772-F, F & H Area Laboratories

DNFSB Recommendation 2004-2
Ventilation System Evaluation

Revision 0
JUNE 2007

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savannah river site

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PREPARED FOR THE U.S. DEPARTMENT OF ENERGY UNDER CONTRACT NO. DE-AC09SR18500

Review and Approval

Facility Evaluation Team Concurrence:

Billy Hudson, DOE, Nuclear Materials Engineering Division — Date: 6/20/07

Timothy H. Gabriel, FHLAB 2004-2 Lead — Date: 6/20/07

Sincerely,

Michael L. Willis, F-Area Chief Engineer — Date: 6/20/07

TABLE OF CONTENTS

Definitions

Active Confinement Ventilation System	A ventilation system that uses mechanical means (e.g., blower) to circulate air within, and remove air from a building or building space through filtration. (DOE-HDBK-1169-2003, DOE Nuclear Air Cleaning Handbook)
Confinement	A building, building space, room, cell, glovebox, or other enclosed volume in which air supply and exhaust are controlled, and typically filtered. (DOE-HDBK-1169-2003, DOE Nuclear Air Cleaning Handbook)
Confinement System	The barrier and its associated systems (including ventilation) between areas containing hazardous materials and the environment or other areas in the facility that are normally expected to have levels of hazardous material lower than allowable concentration limits. (DOE-HDBK-1169-2003, DOE Nuclear Air Cleaning Handbook)
Hazard Category	Hazard Category is based on hazard effects of unmitigated release consequences to offsite, onsite and local workers. (DOE-STD-1027-92, Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports)
Performance Category	A classification based on a graded approach used to establish the NPH design and evaluation requirements for structures, systems and components. (DOE-STD-1021-93, Natural Phenomena Hazards Performance Categorization Guidelines for Structures, Systems and Components)
Ventilation System	The ventilation system includes the structures, systems, and components required to supply air to, circulate air within, and remove air from a building/facility space by natural or mechanical means. (DOE-HDBK-1169-2003, DOE Nuclear Air Cleaning Handbook)

Acronyms

CA	Contamination Area
CAM	Continuous Air Monitor
CVS	Confinement Ventilation System
CW	Co-located Worker (100 meters)
DBA	Design Basis Accidents
DNFSB	Defense Nuclear Facilities Safety Board
DOE	Department of Energy
DSA	Documented Safety Analysis
EBE	Evaluation Basis Earthquake
EC	Evaluation Criteria
EG	Evaluation Guideline
FET	Facility Evaluation Team
HA	Hazard Analysis
HEPA	High Efficiency Particulate Air
MAR	Material at Risk
MCC	Motor Control Center
ME	Main Exhaust System
NPH	Natural Phenomena Hazard
OGE	Off Gas Exhaust System
PC	Performance Category
PGA	Peak Ground Acceleration
REM	Roentgen Equivalent Man
ROM	Rough Order of Magnitude
SAAM	Stack Air Activity Monitoring System
SC	Safety Class
SET	Site Evaluation Team
SFE	Service Floor Exhaust System
SRS	Savannah River Site
SS	Safety Significant
TPC	Total Project Cost
TSR	Technical Safety Requirements
WSRC	Washington Savannah River Company

Executive Summary

This confinement ventilation system evaluation is for the 772-F Analytical Laboratory Facilities at the Savannah River Site (SRS). This evaluation was developed in accordance with the Department of Energy (DOE) evaluation guidance for Defense Nuclear Facility Safety Board (DNFSB) Recommendation 2004-2. The 772-F facility was identified as a part of the SRS 2004-2 evaluation scope. This evaluation included the active ventilation systems in the 772-F Hazard Category 2 Nuclear Facility and the supporting systems in the adjacent 772-4F Radiological facility.

In reviewing the accidents in the DSA only one event scenario was found to fit the Table 4.3 criteria of the 2004-2 Active Confinement Ventilation Evaluation. This event scenario was a Detonation Event with an unmitigated consequence of 0.5 REM Offsite and 137 REM to the Co-Located Worker. These consequences were not found to challenge the 1 to 25 REM Offsite Evaluation Guideline (EG) for Safety Class criteria; however for the Co-Located worker, the unmitigated dose potential does exceed the threshold for Safety Significant limits. In response to the unmitigated 137 REM dose potential to the Co-Located worker, the SRS FHLAB FET and SRS SET requested concurrence from the DOE IRP that the 772-F Confinement Ventilation System be evaluated against the SS performance criteria outlined in Table 5.1. The IRP concurred with this position for evaluating 772-F CVS in a 5/10/07 D. Chung to J. Allison memorandum.

In accordance with the DOE 2004-2 evaluation guidance, SRS evaluated the 772-F active confinement ventilation systems using the SS criteria defined in Table 5.1. To assess functionality for applicable NPH events, PC-2 and PC-3 criteria were usec. PC-3 criterion was only given consideration in the gap analysis as a reflection on the facilities construction/design in the field and the facility as described in the DSA. Eight Table 5.1 performance Gaps were identified between the SS criteria and the facility designs.

After the eight gaps were identified, an evaluation was performed on whether the closure of the gaps is mandatory or discretionary. The evaluation identified that there are no Gaps that require immediate attention based on review of the DSA events and 2004-2 EC Table 5.1 performance criteria. All eight gaps were found to be discretionary in nature since none of the gaps involved a discrepancy between the Safety Basis requirements and the facility designs. In reviewing the discretionary gaps, a number of approaches were developed and evaluated for potential means of closure. None of the modification/upgrades listed as gap closures were perceived as resulting in a discernable reduction in material release reducing the overall risk for any of the bounding accidents in the DSA. If some or all of the discretionary gaps are closed there is perceived benefit in increased system reliability. Increased system reliability by its nature translates into a discernable reduction in accident risk. The FET recommends the closure of Gaps 1,4,6, and 8 should the DOE decide to fund efforts related to system enhancements for improving worker protection.

1. Introduction

1.1 Systems Overview

The primary function of the building and associated system is to support the handling of nuclear materials and chemicals in limited bench-scale quantities for analysis. These operations are performed inside the gloveboxes, radiohoods, radiobenches and shielded cells (containment units) contained within the lab modules.

Building 772-F contains the following process systems and confinement systems used to accomplish the primary mission and functions:

- High-Activity Drain (HAD) and Low-Activity Drain (LAD) systems
- Off Gas Exhaust (OGE) system
- Building and process ventilation systems (Main Exhaust System)
- Containment units (includes: shielded cells, gloveboxes, radiohoods, and radiobenches)
- Building shell

1.2 Ventilation Systems

<u>772-F Facility Description</u>

772-F was designed in 1952 as a Class 1, blast-resistant structure that was built and placed into service in the mid-1950s. 772-F is a Hazard Category 2 facility. Building 772-F is a two-level structure with the lower level below grade. A majority of the early design information as well as most modification documentation is available for the building as well as laboratory modules and equipment.

Mission

The primary mission of the F/H Labs over the last 50+ years has been to support the chemical separations processing activities at Buildings 221-F and 221-H. Samples received from the canyons and other site areas are subjected to the required radiological and chemical quality control/analyses. Results from these analyses are used to effectively and safely operate the canyon facilities. The mission of the F/H Lab has changed very little over the last 40 years of operation. The projected future use of the facility is to continue its mission to support the separations processes and to provide support for the increasing waste management, waste characterization, waste stabilization, and environmental remediation activities at SRS. F/H Labs will also support the tank farm operations, reactor area programs, the Liquid Waste Disposition Unit, to a limited extent the Defense Waste Processing Facility, and site waste characterization efforts.

Function

The primary function of the building and associated systems is to support the handling of nuclear materials and chemicals in limited bench-scale quantities for analysis. These operations are performed inside the gloveboxes, radiohoods, radiobenches and shielded cells (containment units) contained within the lab modules.

Building 772-F contains the following process systems and confinement systems used to accomplish the primary mission and functions:

- High-Activity Drain (HAD) and Low-Activity Drain (LAD) systems
- Off Gas Exhaust (OGE) system
- Building and process ventilation systems (Main Exhaust System)
- Containment units (includes: shielded cells, gloveboxes, radiohoods, and radiobenches)
- Building shell

<u>Sample Process/ HAD and LAD</u>

Low radioactive activity, high radioactive activity and chemical solutions generated by sample analysis, safety shower testing, laboratory sinks, etc. are temporarily placed into below grade transfer tanks. The high-activity returns are transferred by pump to an LR-56S, a High Activity Effluent Transport Truck, via a loading station located exterior to the facility. The LR-56S will transport HAD effluent to 221-H Canyon for processing. The low activity returns are transferred to the Effluent Treatment Project (ETP) for processing and disposal.

Off Gas Exhaust (OGE)

The function of the Off Gas Exhaust (OGE) system is to exhaust and filter air from the Gloveboxes. Air from within the laboratory area is drawn through the glovebox containment enclosure and filtered to minimize the potential for release during normal operation and low energy accident conditions. The HEPA filters installed at the inlet and outlet of each glovebox are non-leak testable type filters. In addition, the air from the glovebox is exhausted into the main header which directs the air flow to the central OGE filtration in Shielded Area B (SAB). The 3 central OGE HEPA filter housings in Shielded Area B (SAB) each consists of two in-place testable HEPA filters in series. After the air is filtered in SAB, the air passes through the OGE fans (3) in the fan room and then into the Main Exhaust System concrete trench before entering the ductwork to 772-4F where it passes through another two stages of HEPA filtration.

772-F has 47 gloveboxes that are ventilated by the 772-F OGE System.

Gloveboxes handle samples that are equal to or greater than Hazard Category 3 Threshold Quantities.

The glovebox shell, window, gloves, and inlet/exhaust filters of the glovebox serve as the Safety Significant (SS), passive confinement boundary.

The OGE system is not a Safety Class SSC and is not required to achieve safe shutdown or to mitigate the consequences of an abnormal condition. Because the OGE system is a passive Safety Significant confinement system, abnormal conditions, such as failure of the exhaust fans and loss of normal and standby electrical power, pose negligible hazard to the facility workers. In addition to the OGE system being a passive SS system, abnormal operations would have negligible impact to onsite personnel outside the facility or on environmental safety relative to the release of radioactive materials and hazardous chemicals.

Should a loss of normal power occur, two of the three OGE fans are supported by Standby Electric power. The two OGE fans supported by Standby Electrical power will continue to maintain negative pressure boundary, however no 772-F Glovebox work is permitted in this configuration in accordance with operating procedures and the Radiological Protection Program.

Main Exhaust (ME)

The function of the main exhaust system is to exhaust all building areas to the outside environment while minimizing the potential of radioactive releases and subsequent onsite and offsite exposure during normal operation and abnormal conditions. The main exhaust system filters air from all radiological areas, radiohoods and radiobenches, gloveboxes, waste handling systems, and the retrospective air sampling and stack monitoring systems.

The main exhaust system has additional contributory streams and several auxiliary exhaust systems within 772-F. The main exhaust system draws room exhaust air from the 772-F fan room, transfer tank cells, shielded cells and the shielded areas as well as conditioned air supplied to the facility. Auxiliary exhaust systems that tie into the main exhaust system are the High and Low Level Drain exhaust systems, the air monitoring system and the OGE system.

The Main Exhaust flow path primarily consists of air that is exhausted through radiohoods, radiobenches, and exhaust intakes in the laboratory modules. The flow path then goes into ductwork leading the flow path down to the service floor level of the building. On the service floor level the ductwork follows separate pathways to the HEPA filters in South side of the service floor and in Shielded Areas A and C. The air then flows into a larger rectangular duct section where it then flows into the main exhaust concrete plenum that runs north to south along the center of the building. This plenum connects to an east and west plenum that is connected to the new concrete vault located south of the sample tunnel by the old stack. A stainless steel duct connects the concrete vault with the main exhaust system of building 772-4F.

Work in radiobenches and radiohoods include analyses of samples that are below Hazard Category 3 Threshold quantities.

Should a loss of normal power occur, the following fans are supported by Standby Electric power and will continue to operate serving their General Service functions:

- All three Air Monitoring fans (One fan operating, two fans in standby).
- Both Low Activity Drain Exhaust fans(One fan operating, one fan in standby)
- Both High Activity Drain Exhaust fans (One fan operating, one fan in standby)
- Two OGE fans (Two fans operating)

The following sections of the main exhaust system are part of the credited passive confinement system: ductwork from the shielded cells, including the shielded cells, to the HEPA filters in shielded area A for the shielded cells (3 filters), the concrete plenum from the old fan room, including the concrete vault, the stainless steel duct from the vault to 772-4F HEPA filter housings and HEPA filters.

Structural

The ventilation tunnel and stainless steel duct between buildings 772-F and 772-4F are qualified for a 0.20g Peak Ground Acceleration (PGA) Evaluation Basis Earthquake (EBE). These structures and components were qualified for a 0.20g PGA EBE.

772-4F Facility Description

The Airborne Radiation Removal Facility (Building 772-4F) was a major addition to the main exhaust system of 772-F that was designed and constructed in the early 1990's. The building has been evaluated as Radiological Facility. The main exhaust from 772-F enters 772-4F through a stainless steel duct. In 772-4F, there are 10 , 5x3, HEPA housings with two In-Place Testable stages of HEPA filters (300 HEPA Filters, total), that make up the filtration system and four main exhaust fans that provide the main exhaust for 772-F. The main exhaust system discharges to a 190 foot stack outside of 772-4F.

The service floor in 772-F exhausts through a fan and a single stage HEPA filtration system in 772-4F that also discharges to the 772-4F stack.

Should a loss of normal power occur, two of the four Main Exhaust fans are supported by Standby Electrical power. Loss of normal power will activate the Process Upset Alarm and Relay (General Service) which will display on the 772-4F Alarm Panel in the Control Room. When the Process Upset alarm occurs, the following conditions will exist:

- Two of the ME fans will stop running leaving one of the ME fans on Standby Power running at a preset , minimum flow rate and another fan on Standby Power in Standby mode.
- The Service Floor exhaust fan will stop running.
- All Six 772-F Air Handling Units (AHU's) supplying conditioned air to 772-F, will stop running.
- The Control Room will receive the Process Upset alarm.

The Process Upset Alarm configuration can also initiated by

- Flow in the concrete trench drops below a set minimum flow rate
- A high vacuum is measured on the Service Floor level of Building 772-F
- Smoke is detected in one of the Air Handling Units (AHU)

The alarms, controls, and configurations associated with the Process Upset mode are not credited for safe shut down or operation of the 772-F and/or 772-4F ventilation systems and are considered General Service Functions.

Structural

Building 772-4F was found to satisfy the low-hazard code requirements (equivalent to PC-2 loads). Building 772-4F is structurally adequate to remain standing after a 0.20g PGA EBE.

The 772-4F stack was found to be adequate for high-hazard loads, including a 0.20g PGA design basis earthquake. In addition, the stack was evaluated and found to be adequate for loads induced by a 0.20g PGA EBE on the HVAC duct attached to the stack.

The Building 772-4F air filtration system has a seismic capacity greater than or equal to a 0.20g PGA EBE and will maintain the confinement of the exhaust path

1.3 Major Modifications

There are no Major Modifications currently underway or planned for any of the 772-F confinement ventilation systems.

2. Functional Classification Assessment

2.1 Existing Classification

The main exhaust system is part of the credited passive confinement system for its SS function: ductwork from the shielded cells, including the shielded cells, to the HEPA filters in shielded area A for the shielded cells (3 filters), the concrete plenum from the old fan room, including the concrete vault, the stainless steel duct from the vault to 772-4F HEPA filter housings and HEPA filters.

2.2 Evaluation

The Consolidated Hazard Analysis (CHA) did not identify any design basis accidents to be included in the DSA that challenge the public Evaluation Guideline from DOE-STD-3009-94 (i.e., in the range of 1-25 REM). One accident in the DSA does exceed the 100 REM Co-Located Worker Criteria in SRS procedure E7 2.25, Functional Classification and DOE Ventilation System Evaluation Guidance document. The Detonation Event in the DSA, yields unmitigated offsite dose consequences of approximately 0.5 REM and 137 REM for co-located workers (Leak Path Factor 1.0 was used).

There are no active SS or SC functions for the existing active confinement ventilation systems associated with the 772-F Confinement boundary. The 772-F and 772-4F active confinement ventilation systems are not credited by the FHLAB DSA to operate during or following any DBA or NPH events.

2.3 Summary

The SS functional classification of the existing 772-F Building passive confinement ventilation system and GS functional classification of the 772-F Main Exhaust active confinement ventilation System components is appropriate.

3. System Evaluation

SRS evaluated the active confinement ventilation systems at the 772-F and 772-4F Analytical Facilities in accordance with Reference 6. Table 4.3 (Attachment 2) was developed from the Central Laboratory Facilities DSA events. Systems were evaluated and documentation was reviewed to confirm system configuration by the associated System Cognizant Engineers for the F&H Laboratories. System configurations were evaluated against the criteria in Table 5.1 and gaps were identified and documented in Attachment 3.

3.1 Identification of Gaps

The 772-F confinement ventilation systems, structures, and components were evaluated against SS, PC-2 & PC-3 criteria found in Table 5.1, Ventilation System Performance Criteria of Reference 6. The events and methodology used for this evaluation were documented in Table 4.3 (Reference 7) and submitted to DOE.

In evaluating the 772-F active confinement ventilation systems against the SS Table 5.1 Evaluation Criteria (EC), the events from Table 4.3 and system classification boundaries for each confinement ventilation system played an important role in determining whether any of the identified gaps and related closure recommendations would be considered discretionary in nature.

While the unmitigated consequences for the detonation event was the only accident that drove the 772-F evaluation to SS criteria, a few other credible events for the DSA were considered in the development of Table 5.1: Sample Spill, 772-F Facility Fire, Deflagration, and 772-4F Facility Fire.

The following is a summary of the 772-F, discretionary gaps with Table 5.1 EC:

Gap number 1: Table 5.1 EC - Pressure differential should be maintained between zones and atmosphere.

> Discretionary Gap. The building layout does not provide confinement zone separation. Pressure instrumentation to monitor pressure differential between building interior and outside environment is not available. The 772-F CVS is designed to maintain the required pressure differential during normal operations. It is not credited in the DSA to operate during or following any DBA event, including NPH events.

Gap number 2: Table 5.1 EC - Confinement ventilation systems shall have appropriate filtration to minimize release.

> Discretionary Gap. The majority of the Main Exhaust filter housings in the 772-F are 1950's vintage and are constructed with a tape-in-place seal at the inlet and discharge of the HEPA filter frame. These filters do not have a positive seating mechanism that provides a robust seal that is independent of human performance during filter installation.

Gap number 3: Table 5.1 EC - Provide system status instrumentation and/or alarms.

> Discretionary Gap. Relay cabinet, CRP-1, located in 772-4F is sensitive to vibration, radiofrequency interference, and/or pressure pulses and is not Safety Significant (SS) or credited as functioning in the DSA. The result of a CRP-1 failure would range from the ventilation system going into a process upset condition (safe mode failure) to a complete shutdown of the ventilation system resulting from the loss of system controls.

Gap number 4: Table 5.1 EC - Interlock supply and exhaust fans to prevent positive pressure differential.

> Discretionary Gap: The interlocks are not SS and are not credited as functioning during or after DBA events. See also Discretionary gap in "Provide system status instrumentation and/or alarms" section.

Gap number 5: Table 5.1 EC - Reliability of control system to maintain confinement function under normal, abnormal and accident conditions.

Discretionary Gap: The interlocks are not SS and are not required or credited to function during or after DBA events.

Gap number 6: Table 5.1 EC - Control components should fail safe.

Discretionary Gap: The controls are not SS and are not required or credited to function during or after DBA events

Gap number 7: Table 5.1 EC - Design supports the periodic inspection & testing of filters and housing, and test & inspections are conducted periodically.

Discretionary Gap, The installed design for most of the Inlet and discharge HEPA filters of the gloveboxes in 772-F does not permit In-Place Leak Testing.

Gap number 8: Table 5.1 EC - Backup electrical power shall be provided to all critical instruments and equipment required to operate and monitor the confinement ventilation system.

Discretionary Gap – Electrical cables are run in open cable trays from 772-4F over the middle of the 772-F roof to the 254-9F diesel generator located on the west side of 772-F. A detonation event could potentially damage these cables and standby power capability (GS) to the 772-4F ventilation system could be lost.

3.2 Gap Evaluations

The 772-F and 772-4F active confinement ventilation systems were compared with SS system performance criteria in Table 5.1 of Reference 6. In order to perform this evaluation, ventilation and support systems documentation were reviewed to confirm system configuration. Systems were then evaluated against the criteria in Table 5.1; eight gaps that are discretionary in nature were identified and documented in Attachment 3.

3.3 Modifications and Upgrades

The discretionary gaps identified in Attachments 3, were reviewed by the Design Authority Engineer and other F&H Laboratory personnel and recommendations for closure of the gaps were developed. The recommendations for closure are summarized below.

Gap number 1

Proposed closure for Gap: Enclose laboratory corridors with doors, install a secondary set of doors at exterior exit on west side of 772-F main floor, and provide zone differential monitoring capabilities. This effort would consist of installing seven corridor doorways at the CA boundaries of the central laboratory spaces, installation of a set of doors to perform an airlock function on main floor west side exit door, installation of magnehelic gauges around Laboratory CA boundary, some minor electrical power runs to magnehelic gauges and doors, and the installation of a pressure gauge and transmitter for monitoring the pressure differential between atmosphere and building interior spaces. Implementation of these proposed modifications will also include training, roundsheet revisions, and revision/generation of procedures. The total ROM cost estimated for this gap closure is $832,000 to $1,664,000.

Recommendation: The modification associated with the closure of this gap moves the facility closer to meeting current code and standard definition of Zone boundaries and aids in adding a minor ability to minimize the spread of contamination between internal zones but does not mitigate the consequences of the Detonation event. There is no discernible benefit or significant risk reduction associated with this gap resolution for any of the bounding accidents in the DSA. The FET does not recommend implementing this gap closure for the mitigation of an event but does recommend implementation of this gap closure for the perceived benefit in increased system reliability.

Gap number 2

Proposed closure for Gap: The closure of this gap would require the replacement of the existing ductwork, clean and dirty plenums, and 26 filter housings (Related to Radiological Laboratory Modules) with a more current design that contains an engineered installation aid, boundary around filter shell, and In-Place Leak Testing of filters. Though the new hardware cost are estimated high, the D&R work associated the the existing ductwork, plenums, and filter housing is expected to be the biggest expense associated with this modification. The total ROM cost estimated for this gap closure is $6.2 to $12.4 Million.

Recommendation: This ventilation upgrade primarily brings the immediate laboratory module filtration units up to more current codes and standards but does not improve facility worker protection. The existing location of these filter units is in a remote location that has historically required Radiological Control Operations monitoring and PPE for access. Should a filter installation leak the consequences to the facility worker are low and would have little effect on the environment in which they are located. There is no discernible benefit or significant risk reduction associated with this gap resolution for any of the bounding accidents in the DSA. The FET does not recommend implementation of this modification for the mitigation of the Detonation event consequences.

Gap number 3,4,5, & 6

Proposed closure for Gap: Replace existing CRP-1 Relay Cabinet with a PLC bus system as well as perform upgrade of existing system controls. The replacement of the relay cabinet can be accomplished by relocating an existing PLC with existing tie-ins from air compressors to 772-4F where the CRP cabinet is currently located. The relocation of this PLC bus will utilize a number of existing instrument line trays but will require replacement of existing/installation new cable and conduit runs. The total ROM cost estimated for this gap closure is $2.5 to $5 Million.

Recommendation: While the implementation of this gap closure, with respect to Gaps 4 and 6, does ensure more rigor is put into maintaining the reliability of the Interlocks between the Supply and Exhaust, it does not provide a means of mitigation for the consequences of the Detonation event. There is no discernible benefit or significant risk reduction associated with this gap resolution for any of the bounding accidents in the DSA. The FET does not recommend implementing this gap closure for the mitigation of an event but does recommend implementation of this gap closure for the perceived benefit in increased system reliability.

Gap number 7

Proposed closure for Gap: Due to the small diameter welded pipe duct design and limited space available with the existing glovebox installations (except Lab 175) in 772-F Laboratory modules, it is not possible to modify the existing gloveboxes to permit an aerosol leak test for both the Inlet and discharge HEPA filtration. Therefore in order to close this gap, all glovebox units that are needed for active Analytical Sample analysis will need to be replaced with new glovebox containment units along with lab utilities renovation work as well. The ROM cost estimated for this gap closure is $200,000 to $1 Million per glovebox. The total modification ROM ($9 to $45 Million) for this gap closure is dependent on the number of gloveboxes needed to support the mission of the lab, the lab currently has and maintains 47 gloveboxes.

Recommendation: This ventilation upgrade primarily brings the gloveboxes and associated filtration units up to more current codes and standards but does not provide an improved means of facility worker protection or any perceived mitigation of the consequences associated with the Detonation event. Should a glovebox filter installation leak, the occurrence does not result in a significant release in inventory. Based on current missions and administrative limits imposed on Lab Module work, credited programs such as Radiological Protection Program and Lab Module Checkout (which includes OGE operability checks and radiological surveys) are sufficient to detect any leakage before it has a significant impact to the FW. These credited programs ensure that routine evaluations are performed on the glovebox (including contamination, conditions, and delta P) to ensure the worker protection design feature. Also an abnormal event would drive the lab workers to evacuate the lab modules. There is no discernible benefit or significant risk reduction associated with this gap resolution for any of the bounding accidents in the DSA. The FET does not recommend implementation of this modification for the mitigation of the Detonation event consequences.

Gap number 8

Proposed closure for Gap: Replace and relocate cables and cable trays for both Normal Electrical Power and Standby Electrical Power with new cables in environmentally shielded, seismically qualified cable trays. The new proposed route is still across the roof of 772-F but is roughly 45 feet south of the existing cable route and lies above the change rooms instead of the lab modules where the postulated events could occur. After the cables leave the roof top of 772-F and are routed to 772-4F, a new route/support structure must be designed and installed. The total ROM cost estimated for this gap closure is $400,000 to $800,000.

Recommendation: Based on review of the bounding accidents in the DSA, there is not a discernible benefit or significant risk reduction associated with the gap resolution. While this gap closure modification will provide a more robust protected Power Cable Run the likelihood that a Detonation event would breach the roof and at the specific location that the current cable run exists, is low. There is no discernible benefit or significant risk reduction associated with this gap resolution for any of the bounding accidents in the DSA. The FET does not recommend implementing this gap closure for the mitigation of an event but does recommend implementation of this gap closure for the perceived benefit in increased system reliability.

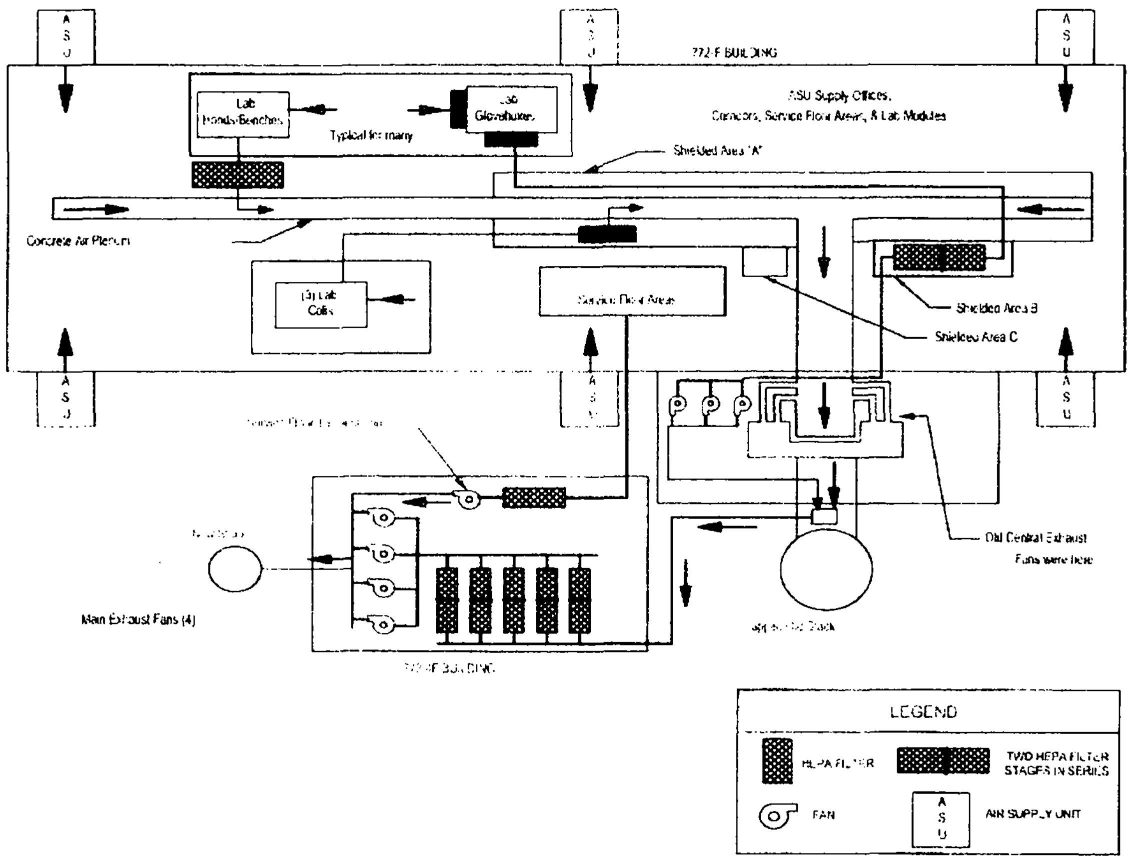
4. Conclusion

The evaluation identified that there are no Gaps that require immediate attention based on review of the DSA events and 2004-2 EC Table 5.1 performance criteria. All eight gaps were found to be discretionary in nature, since none of the gaps involved a discrepancy between the Safety Basis requirements and the facility designs. In reviewing the discretionary gaps, a number of approaches were developed and evaluated for potential means of closure. None of the modification/upgrades listed as gap closures were perceived as resulting in a discernable reduction in material release reducing the overall risk for any of the bounding accidents in the DSA. If some or all of the discretionary gaps are closed, there is perceived benefit in increased system reliability. Increased system reliability, by its nature, translates in to a more effective worker protection program. The FET recommends the closure of Gaps 1, 4, 6, and 8 should the DOE decide to provide funding for efforts related to system enhancements for improving worker protection.

References

1. WSRC-SA-96-26, CENTRAL LABORATORY FACILITY – BUILDINGS 772-F, 772-1F, AND 772-4F SAFETY ANALYSIS REPORT, Rev. 4, Washington Savannah River Company, Aiken, SC, November 2006.
2. WSRC-TR-2006-00099, Consolidated Hazards Analysis for Operations in Building 772-F, 772-1F, 772-4F, and B-25, Rev. 1, Washington Savannah River Company, Aiken, SC, July 2006.
3. S-CLC-F-00595, GLOVEBOX EXPLOSION CONSEQUENCE ANALYSIS FOR THE F/H LABS, Rev. 0, Washington Savannah River Company, Aiken, SC, August 2006
4. Savannah River Laboratory Memorandum DPST-79-359, from M. W. Lee & D. H. Stoddard to J. T. Buckner, STATISTICAL ANALYSIS OF HEPA FILTRATION SYSTEMS, May 1, 1979
5. Conduct of Engineering and Technical Support, WSRC Procedure Manual E7, Procedure 2.25, Functional Classification, Rev. 14, Westinghouse Savannah River Company, Aiken, SC, November 2004.
6. Deliverables 8.5.4 and 8.7 of Implementation Plan for DNFSB Recommendation 2004-2, Ventilation System Evaluation Guidance for Safety-Related and Non-Safety-Related Systems, U.S. Department of Energy, Washington, DC, January 2006
7. WSRC Memorandum M&O-FHO-2007-00011, from R. W. Cansler to C. A. Everatt, 772-F, DNFSB 2004-2 Active Confinement Evaluation (Table 4.3), March 8, 2007.
8. WSRC Memorandum M&O-FHO-2007-00039, from M. L. Willis to K. W. Stephens, 772-F, DNFSB 2004-2 Active Confinement Evaluation (Table 5.1), May 22, 2007.
9. WSRC-TS-95-18, F-AREA CENTRAL LABORATORY FACILITY, BUILDINGS 772-F,772-1F,772-4F TECHNICAL SAFETY REQUIREMENTS, Rev. 5, Washington Savannah River Company, Aiken, SC, November 2006.

Attachment 1 – 772-F and 772-4F General Arrangement


A
S
U
Typical for many
Shielded Area B
Shielded Area C
Main Exhaust Fans (4)
LEGEND
HEPA FILTER
TWO HEPA FILTER
STAGES IN SERIES
FAN
AIR SUPPLY UNIT

Attachment 2 - 2004-2 Table 4.3, 772-F Ventilation Systems

Confinement Documented Safety Analysis Information										
Facility 772-F			Hazard Category 2						Performance Expectations	
Bounding Accidents	Type Confinement		Doses (rem) Bounding unmitigated/mitigated	Confinement Classification			Function	Functional Requirements	Performance Criteria	Compensatory Measures
	Active	Passive		SC	SS	DID				
Detonation		X(a)	Unmitigated 0.5 for offsite 137 for onsite Mitigated 7.7 E-3 for offsite 0.16 for onsite		x		Confinement for collocated worker	Explosion	Maintain Passive Confinement Boundary (b)	None

Notes

(a) 4.9 E-3 one stage of HEPA filters per Ref. 4 is used as a LPF in DSA (Ref. 1).
(b) This function was evaluated in Ref. 3. Ref. 3 is a qualitative evaluation that was based on the design of the facility and location of the credited components. The evaluation found that the filters and ductwork in 772-F may not survive a detonation but the majority of the 772-F confinement boundary shell, concrete trench, ductwork from the trench to 772-4F, as well as the credited components in 772-4F were found to survive the accident scenario. The facilities ability to perform this function is verified by the inspection and testing conducted for normal operation.

Credible events from the CHA are listed in the Events Table. Events determined to be excluded from consideration and the basis for this decision is also delineated below.

Definitions
CW Co-located Worker (Receptor Consequences were determined using 50% Meteorology)
NC Not Calculated

Table 1
Events

Event Category	Facility Applicability	Unmitigated Consequences
Spill	772-F	CW 1.0E+01 REM Public 1.9E-02 REM
Earthquake/Fire	772-F	CW 1.9E+01 REM Public 2.4E-01 REM
Deflagration	772-F	CW 2.1E+00 REM Public 7.7E-3 REM
Fire	772-4F	CW NC Public 3.58E-06 REM

Events to be excluded

1) Flooding and precipitation events
Based on the SAR section 1.5.1 and 3.3.2.3, flooding is not considered a credible initiator due to the topography of SRS and surrounding area, therefore eliminating the requirement for any further analysis.

2) Extreme temperature and lightning events
Based on the SAR section 3.3.2.3, these events may adversely affect operations but do not result in accident sequences that lead to direct releases of radioactive materials, therefore eliminating the requirement for any further analysis.

3) Adjacent events
Based on the SAR section 3.3.2.3, adjacent fires and explosions are not considered credible accident initiators for the release of radioactive material and are not analyzed further.

4) Aircraft and vehicle impact events
Based on the SAR section 3.3.2.3, these events are bounded by the full facility fire event.

5) Earthquake event
Based on the SAR section 3.4.2.6, the consequences for Building 772-F during a DBE are negligible when compared to the consequences of a full facility fire in Building 772-F. Therefore, only the consequences of a facility fire in Building 772-F have been calculated based on the radiological inventory.

Attachment 3 - 2004-2 Table 5.1, 772-F Ventilation Systems Performance Criteria

Evaluation Criteria	Discussion	Reference
	I - Ventilation System – General Criteria	
Pressure differential should be maintained between zones and atmosphere.	The 772-F confinement ventilation system (CVS) is designed to maintain the building at a lower pressure relative to the environment for normal operating conditions. Annual flow testing is performed to verify and validate system performance in conjunction with the periodic full facility air balance. Interlocks exist for the supply and exhaust fans to ensure the supply air cannot overcome the exhaust. The building provides a passive confinement barrier. **References** J-J4-F-2987 Rev. 1, SE5-2-2003023 Rev 3, SE5-2-2003243 Rev. 9, W845778 Rev. 3, P-PE-F-2634 Rev. 0, W845695 Rev. 3, W845696 Rev. 3, M-M6-F-3010 Rev. 5, M-M6-F-3013 Rev. 4, W2017720 Rev. 4, TP-03-772F-MEXH-01 **Gap Analysis** Discretionary Gap The building layout does not provide confinement zone separation. Pressure instrumentation to monitor pressure differential between building interior and outside environment is not available. The 772-F CVS is designed to maintain the required pressure differential during normal operations. It is not credited in the DSA to operate during or following any DBA event, including NPH events.	**DOE-HNBK-1169 (2.2.9) ASHRAE Design Guide, Section 2**
Materials of construction should be appropriate for normal, abnormal and accident conditions.	Materials of construction for the ventilation duct are stainless steel and concrete. The HEPA filter housings are stainless steel. Old HEPA filter housing are constructed per SRS drawings, new HEPA filter housings are constructed by Flanders/CSC. Gasket material is neoprene. Exhaust fans are constructed of galvanized/carbon steel. The portion of ventilation duct that runs under ground is constructed from concrete. The materials of construction were selected to resist chemical attack, steel and concrete were coated to provide additional protection. **Most 772-F containment units (Radiobenches, Radiohoods, and Gloveboxes) are constructed of Stainless Steal shells, glass viewing windows, and neoprene gaskets but some wooden shelled Fume hoods are still in existence in the facility. The few remaining wooden Fumehoods are either out of service or not in a lab module and the introduction of flammables is prohibited, and/or Analytical work is not permitted.** **References** W813522, W813293, W833519, W2017704, W2017695 W749265. **Gap Analysis** No Gap The ventilation system is designed for laboratory process operations. The design and materials of construction will maintain structural integrity to provide passive confinement/containment.	**DOE Nuclear Air Cleaning Handbook 1169 Section 2.2.5 – Corrosion ASME AC-1**

Evaluation Criteria	Discussion	Reference
	1 - Ventilation System – General Criteria	
Exhaust system should withstand anticipated normal, abnormal and accident system conditions and maintain confinement integrity.	The active CVS was designed for normal operating conditions. However, the Main Exhaust system is not challenged by localized low energy events (drops, spills, and over-pressurization of containers) and is expected to perform under these accident conditions. The Main Exhaust is not credited in the DSA to operate during or following any DBA event, including NPH events. However, the Main Exhaust system inclusive of 772-4F ducts and filter housings has been evaluated to withstand an earthquake and was qualitatively evaluated for an explosion. In both events, earthquake and explosion, the Main Exhaust components which are exterior to 772-F maintain structural integrity to provide for the passive confinement function of contamination control. Also, the buildings 772-F and 772-4F housing the exhaust system components are designed as SS for earthquake. Additionally, building 772-F was evaluated and found to be adequate for PC-3 wind loads (i.e., 137-mph fastest-mile wind speed tornado) and thus would protect the building radiological inventory from the effects of a tornado or high winds. __Reference__ WSRC-SA-96-26, Rev. 4, Central Laboratory Facility Buildings 772-F, 772-1F, and 772-4F Safety Analysis Report WSRC-TR-2006-00099, Rev. 1, CHA for Operations in Building 772-F, 772-1F, 772-4F, and B-25 __Gap Analysis__ No Gap. The ventilation system is not credited in the DSA to operate during or following any DBA event, including NPH events.	**DOE-HNBK-1169 (2.4) ASHRAE Design Guide**

Evaluation Criteria	Discussion	Reference
Confinement ventilation systems shall have appropriate filtration to minimize release.	All credited exhaust filters in Building 772-4F are contained in filter housings. These housings hold a pre-filter and two stages of HEPA filters. Housing is total welded construction (Code Welding). Housing conforms to leak tightness per criteria of DOE Nuclear Air Cleaning Handbook. The HEPA filter housing is designed and manufactured to meet ASME N509. HEPA filter housing specification consists of 11 and 14 gauge 304 stainless steel. Each 772-4F filter housing has a common differential pressure gauge across each stage of filtration. This differential pressure gauge is used to determine the dust loading of the filters. All credited Main Exhaust filters in Building 772-F are credited for facility worker protection. These filters are contained within tape in place filter housings per 1954 SRS drawings. These housings hold a pre-filter and single stage of HEPA filters. HEPA filter housing specification consists of 16 gauge stainless steel ducting with angle framing. Each 772-F filter bank has a common differential pressure gauge across each stage of filtration. This differential pressure gauge is available to determine the dust loading of the filters. The filter testing program periodically tests HEPA filters in accordance with national standards (American Society of Mechanical Engineers N510, "Testing of Nuclear Air Cleaning Systems") to ensure the required particle-removal efficiency of the filters. The operability of the above exhaust systems is demonstrated by any one HEPA filter stage between the source of the airborne material and the release point to the atmosphere. The HEPA filter testing program ensures the 772-F ME System HEPA filters in Building 772-4F, and the 772-F Shielded Cells HEPA filters perform the required filtration function. Each set of credited HEPA filters in the Main Exhaust is leak-tested annually to verify the filter installation leakage rate. The HEPA filter systems meet the filtration requirements for normal operation. The ventilation systems are not credited in the DSA to operate during or following any DBA event, including NPH events. A review of the systems airflow readings has been performed and no filters were identified as being installed at a location with a flow rate exceeding the manufacturers rated air flow for that filter. **<u>Exhaust HEPA Housing and Filter</u>** <u>772-F</u> Most of the housings were fabricated per SRS drawings with original construction of building 772-F in 1954. Flanders Filter Model Z95296 (24" x 30" x 11-1/2") (HEPA Filter) 99.97% efficient, Fire Retardant Plywood frame, separator less, Neoprene gaskets, SST faceguards both sides. <u>772-4F</u> Flanders Model (E-5) 5 X 6 GG-F2 (304) Type 3 (Cabinet) Flanders Model GG-F (24" x 24" x 11-1/2") (HEPA Filter) 99.97% efficient, Fire Retardant Plywood or SST frame, separator less, with extractor clips, 3/4" deep channel filled with fluid sealant upstream, SST faceguards both sides. <u>Off Gas Exhaust</u> Inlet and exhaust filters of the 772-F gloveboxes are manufactured by Flanders per the site HEPA Filter spec. These HEPA filters vary in size and flow rate based on configuration and flow rate of the glovebox they are to be installed. Most 772-F Glovebox Inlet and discharge HEPA filters are installed in housings that are part of the glovebox shell and/or the filter itself is flanged to the box shell. **<u>Reference</u>** M-M6-F-3013 Rev. 4, W157346 Rev. 50, , TP-03-772F-MEXH-01 **<u>Gap Analysis</u>** Discretionary Gap. The majority of the Main Exhaust filter housings in the 772-F are 1950's vintage and constructed with a tape-in-place seal at the inlet and discharge of the HEPA filter frame. These filters do not have a positive seating mechanism that provides a robust seal that is not dependent on human performance during filter installation.	**DOE Nuclear Air Cleaning Handbook 1169 Section 2.2.1 Airborne Particulate and Gases** **SRS Engineering Standard 15888** **ASME AG-1 Table FC-5140** **ASME N509-2002** **ASME N510** **WSRC-TM-95-1, M-SPP-G000243, HEPA Filter Specification**

Evaluation Criteria	Discussion	Reference
	2 - Ventilation System – Instrumentation & Control	
Provide system status instrumentation and/or alarms.	The CVS(s) are controlled and monitored with installed instrumentation. Alarms are received from these instruments in the Control Room for process upset, loss of normal power, low fan pressures, and low system operating pressures (motor not running). Other system parameters are monitored through the use of round sheets. Local instrumentation is adequate for normal operation. The ventilation systems are not credited in the DSA to operate during or following any DBA event, including NPH events. **Reference** SE5-2-2003023, SE5-2-2003025, SE5-2-2003026, SE5-2-2003243, W2017720, W845697 **Gap Analysis** Discretionary Gap. Relay cabinet, CRP-1, located in 772-4F is sensitive to vibration and/or pressure pulses and is not Safety Significant (SS) or credited as functioning in the DSA. The result of a CRP-1 failure would range from the ventilation system going into a process upset condition (safe mode failure) to a complete shutdown of the ventilation system resulting from the loss of system controls.	**DOE Nuclear Air Cleaning Handbook 1169** **AHSRAE Design Guide (Section 4)** **ASME AG-1**
Interlock supply and exhaust fans to prevent positive pressure differential.	The 772-F and 772-4F CVS(s) are equipped with interlocks for the supply and exhaust fans in effort to ensure the supply air cannot overcome the exhaust **Reference** J-J4-F-2987 Rev. 1, SE5-2-2003023 Rev. 3, SE5-2-2003243 Rev. 9, W845778 Rev. 3, W845695 Rev. 3, W845696 Rev. 3, M-M6-F-3010 Rev. 5, M-M6-F-3013 Rev. 4, W2017720 Rev. 4, TP-03-772F-MEXH-0 **Gap Analysis** Discretionary Gap: The interlocks are not SS and are not credited as functioning during or after DBA events. See also Discretionary gap in "Provide system status instrumentation and/or alarms" section.	**DOE-HNBK-1169** **ASHRAE Design Guide (Section 4)**
Post accident indication of filter break-through.	During normal operation, the current system to detect airborne contamination for the 772-F Main Exhaust and 772-4F Main Exhaust Ventilation systems is performed by the Stack Air Activity Monitoring System. However, the 772-F and 772-4F Main Exhaust systems are credited in the DSA for passive confinement and not for active confinement during or following any DBA event, including NPH events. Accidents associated with the 772-F Off Gas Exhaust systems are primarily localized and internal to the overall 772-F building CVS. The 772-F Off Gas Exhaust system is also credited for having a passive confinement strategy. The Safety Significant passive confinement boundary for the Off Gas Exhaust system is performed by the Glovebox shell, windows, gloveports, gloves, HEPA filter housings, and HEPA filters. Indication of post accident filter break though of the glovebox inlet filters can be detected by either the credited (FW) laboratory module checkout, differential pressure gauges (not credited), or the local low volume Continuous air samplers (not credited). Indication of post accident filter break though of the glovebox outlet filters can not be detected. **References** M-M6-F-3505 Rev. 0, M-M6-F-3508 Rev. 2, M-M6-F-3989 Rev. 1, M-M6-F-3990 Rev. 0, M-M6-F-3991 Rev. 0, M-M6-F-3992 Rev. 0 WSRC-TS-95-18 Rev. 5, Central Laboratory Facility Buildings 772-F, 772-1F, and 772-4F Technical Safety Requirements WSRC-SA-96-26, Rev. 4, Central Laboratory Facility Buildings 772-F, 772-1F, and 772-4F Safety Analysis Report **Gap Analysis** No Gap.	**DNFSB Tech 34**

Evaluation Criteria	Discussion	Reference
Reliability of control system to maintain confinement function under normal, abnormal and accident conditions.	The CVS has no credited automatic control features (except for the interlocks for the supply and exhaust fans). The Main Exhaust system is a constant volume system, an air flow controller adjusts variable inlet vanes to maintain a preset flow rate. The Air Supply system has an interlock connected to the Main Exhaust system so that all air handling units and all but one exhaust fan is shut down due to an abnormal exhaust condition (Process Upset). The ventilation systems and the associated instrumentation and controls in the FH LAB are not considered to be Safety Class items and are not required to achieve safe shutdown. Four one third capacity exhaust fans are provided for redundancy and two of the four fans are serviced by standby electrical power to increase worker safety and contamination control (although not required for safe shutdown). In the unlikely event of an instrument malfunction, the ventilation system enters a Process Upset, and would have no adverse safety impact on facility personnel or the environment (i.e., radiological and hazardous chemical releases) The design of the ventilation systems in Buildings 772-F and 772-4F has incorporated various personnel protection features that relate to the removal of airborne radioactivity and or other hazardous material from within these buildings. These ventilation systems ensure that the airborne contamination levels within these buildings are as low as reasonably achievable. **<u>Reference</u>** M-M6-F-2990, M-M6-F-3010, M-M6-F-3013, W2017693, SE5-2-2000617, SE5-2-2003023, SE5-2-2003243 **<u>Gap Analysis</u>** Discretionary Gap The interlocks are not SS and are not expected or credited to function during or after DBA events.	**DOE Nuclear Air Cleaning Handbook 1169** **Section 2.4** **ASME AG-1**
Control components should fail safe.	During design of Building 772-4F and associated equipment, a Design Process Hazard Review was used to determine the "Fail Safe" state for all Main Exhaust components and all air handling units. The results of this review were incorporated in the final design and reviewed during and after start-up testing. The main exhaust system has four one third capacity centrifugal fans with variable inlet vanes, automatic discharge dampers, and manual inlet and discharge isolation dampers. The automatic discharge dampers are interlocked with the fans to open upon operation of the fans and to close when the fans stop to prevent "windmilling" (reverse rotation). The automatic discharge dampers will fail in the open position upon a loss of normal power or instrument air. A velocity probe located in the concrete plenum on the service floor is used to determine the velocity of the air. This probe is attached to a transmitter located in Building 772-4F. The variable inlet guide vanes are used to maintain constant air flow. The flow controller will open the inlet vanes when the flow needs to be increased or will close them when the flow needs to be decreased. This system adjusts the inlet vanes on the main exhaust fan to obtain the desired flow rate. The ventilation systems and the associated instrumentation and controls in the FH LAB are not considered to be Safety Significant items and are not required to achieve safe shutdown. In the event of loss of power involving the Ventilation System, the system has an interlock so that all air handling units and all but one exhaust fan is shut down due to an abnormal exhaust condition (Process Upset). Two Main Exhaust fans and sufficient control to operate one exhaust fan are connected to standby power. If power continued to be supplied to the control room, indication of the fans operating would be available. **<u>Reference</u>** M-M6-F-2990, M-M6-F-3010, M-M6-F-3013, W2017693, SE5-2-2000617, SE5-2-2003023, SE5-2-2003243 **<u>Gap Analysis</u>** Discretionary Gap The controls are not SS and are not expected or credited to function during or after DBA events	**DOE-HNBK-1169 (2.4)**

Evaluation Criteria	Discussion	Reference
	3 - Resistance to Internal Events – Fire	
Confinement ventilation systems should withstand credible fire events and be available to operate and maintain confinement.	The CVS(s) are not required to remain operational during credible fire or explosion events. In case of a 772-F facility fire, the exhaust fans and filters are located in the 772-4F building and are protected from the heat damaging effects by physical separation and passive and active fire prevention systems. Fire detection results in a reduction in exhaust flow which minimizes blinding and heat effects on the 772-4F Filtration. The design basis fire is a full facility fire which will breach the building shell. Building 772-4F lacks any significant combustible materials. Exhaust ductwork is heavy gauge galvanized/stainless steel and is inherently fire resistant. The sprinkler systems for Building 772-F/4F are hydraulically designed for ordinary Hazard Group 2 occupancy as shown in the Fire Hazards Analysis for the Buildings. The fire detection and alarm systems, in addition to being normally powered, can receive standby electrical power from the Building standby diesel generators. The fire alarm system panels also contain a battery backup power supply. The Fire Protection Program ensures that combustible materials are controlled to minimize the potential for fire in such locations. The 772-F Building as well as the Main Exhaust system are designated as SS and are required to provide a passive barrier under explosion conditions. The primary function is to provide confinement of hazardous material, thereby, providing contamination control and worker protection for the CW. This is a passive function provided by the building structural elements and outer structures, ductwork from the 772-F concrete plenum to the 772-4F HEPA filter housings, the 772-4F HEPA filter housings and at least one stage of HEPA filters. **Reference** **F-FHA-F-00003 Rev. 1** **Gap Analysis** No Gap.	**DOE-HNBK-1169 (10.1)** **DOE-STD-1066**
Confinement ventilation systems should not propagate spread of fire.	The basic design of these facilities contributes to fire prevention and lack of propagation through the use of noncombustible construction and compartmentalization of laboratory/process areas. However wood was used in the 772-4F attic construction and if it became involved in a fire, it could lead to a full facility fire. This fire event is bounded in the DSA by a full facility fire as an Anticipated event. Smoke and heat detectors are provided in essential areas of the buildings, including heat detectors in active gloveboxes. The buildings are provided with a partial-coverage wet-pipe sprinkler system suppression system in various locations. Smoke detectors located in the Building 772-F air handling units (AHUs) will disable the AHUs and Building 772-4F main exhaust fans (except one) to protect the Building 772-4F HEPA filters. **Reference** F-FHA-F-00006 Rev. 4 **Gap Analysis** No Gap.	**DOE-HNBK-1169 (10.1)** **DOE-STD-1066**

Evaluation Criteria	Discussion	Reference
	4 - Resistance to External Events – Natural Phenomena – Seismic	
Confinement ventilation systems should safely withstand earthquakes.	Buildings 772-F/772-4F, ME components are required to provide passive confinement protection under earthquake accident conditions. The primary function is to provide confinement of hazardous material, thereby providing contamination control and worker protection for the CW. This is a passive function provided by the ductwork from the 772-F concrete plenum to the 772-4F HEPA filter housings, the 772-4F HEPA filter housings and at least one stage of HEPA filters. Buildings 772-F and 772-4F (including the Building 772-4F stack) are structurally adequate to remain standing for up to a 0.20g Peak Ground Acceleration (PGA) earthquake. In addition, the Building 772-4F air filtration system (HEPA filters and ducts) was judged to be adequate for up to a 0.20g PGA earthquake. The ventilation systems are not credited in Section 3.4.2.18 of the DSA to operate during or following a seismic event. In order to be able to credit (or, if not credited, increase reliability to assume survival in a DBE) an active CVS, if needed for NPH, several major components, including the fans, backup diesel power, relay cabinets, and main power supply path would require major renovation. **Reference** WSRC-SA-96-26, Rev. 4, Central Laboratory Facility Buildings 772-F, 772-1F and 772-4F Safety Analysis Report **Gap Analysis** No Gap.	**ASME AG-1 AA** **DOE 0420.1B** **DOE-HNBK-1169 (9.2), Section 2.4 – Emergency Consideration UBC, 1979** **SBC, 1979**
	5 - Resistance to External Events – Natural Phenomena – Tornado/Wind	
Confinement ventilation systems should safely withstand tornado depressurization.	The CVS(s) are not credited in Section 3.4.2.7 of the DSA to perform any safety function during or following a tornado event. **References** WSRC-SA-96-26, Rev. 4, Central Laboratory Facility Buildings 772-F, 772-1F, and 772-4F Safety Analysis Report **Gap Analysis** No Gap.	**DOE 0420.1B** **DOE-HNBK-1169 (9.2), Section 2.4 – Emergency Consideration**
Confinement ventilation systems should withstand design wind effects on system performance.	As discussed in the DSA, Building 772-F was designed as a Class I, blast-resistant concrete structure in accordance with Specification 3580 and was determined to be structurally adequate for Performance Category 3 wind loads (i.e., 137-mph fastest-mile wind speed tornado). Because of the structural integrity of Building 772-F, no radiological releases are expected from Design Basis Straight Winds. The ventilation systems are not credited in Section 3.4.2.7 of the DSA to perform any safety function during or following a high winds event. **References** WSRC-SA-96-26, Rev. 4, Central Laboratory Facility Buildings 772-F, 772-1F, and 772-4F Safety Analysis Report **Gap Analysis** No Gap.	**DOE 0420.1B** **DOE-HNBK-1169 (9.2)**

Evaluation Criteria	Discussion	Reference
	6 - Other NP Events	
Confinement ventilation systems should withstand other NP events considered credible in the DSA where the confinement ventilation system is credited.	The CVS(s) are not credited in the DSA to perform any safety function during or following any other NP event. **References** WSRC-SA-96-26, Rev 4. Central Laboratory Facility Buildings 772-F, 772-1F, and 772-4F Safety Analysis Report **Gap Analysis** No Gap.	**DOE 0420.1B** **DOE-HNBK-1169 (9.2), Section 2.4 – Emergency Consideration**
	7 – Range Fires/Dust Storms	
Administrative Controls should be established to protect confinement ventilation systems from barrier threatening events.	Wild land fire impacts were evaluated for F/H Lab (DSA, Section 3.4.2.3) as another Extremely Unlikely initiator for a full facility fire, which is already the worst case fire possible. The ventilation systems are not credited in the DSA to perform any safety function during or following a full facility fire event. **References** WSRC-SA-96-26, Rev 4. Central Laboratory Facility Buildings 772-F, 772-1F, and 772-4F Safety Analysis Report **Gap Analysis** No Gap.	**DOE 0420.1B**

Evaluation Criteria	Discussion	Reference
	8 – Testability	
Design supports the periodic inspection & testing of filters and housing, and test & inspections are conducted periodically.	The 772-4F HEPA filter housings were designed and manufactured to meet ASME N509 requirements. Each filter location in the 772-4F HEPA filter banks has a set of ½" quick disconnect type test connections for performance testing (PAO/DOP). The 772-F HEPA filter housings have access ports upstream and downstream of the HEPA filters which provide access to the exhaust stream locations needed for In-Place Leak testing. The 772-F gloveboxes installation and design vary based on time of installation. Most of the gloveboxes in the facility are from the late 1970's and early 1980's. Per the DSA the glovebox shell, Gloveports, Glovebox gloves, HEPA enclosure, and HEPA filters are credited for containment (FW) not filtration. Most 772-F Glovebox Inlet and discharge HEPA filters are installed in housings that are part of the glovebox shell or the filter itself is flanged to the box shell. Due to the design of these filters installations, In-Place Leak testing is not feasible. In-place leak testing is performed at scheduled intervals for installed testable HEPA filter systems to detect deterioration of filters, gaskets or other causes that could result in leaks. The facility has an established PM program which requires the Vital Safety Systems HEPA filters to undergo in-place leak testing every 12 months. In-place leak testing is performed for this HEPA filter system in accordance with Site Engineering Standards. **References** Manual 2Y1 "*HEPA Filter Testing Procedures*", Procedure 104 "*General Surveillance Testing of HEPA Filters*". Manual 2Y1 "*HEPA Filter Testing Procedures*", Procedure 505 "*Testing HEPA Filter Systems for (F) Area*" S5-2-7592 Rev. 7, S5-2-9439 Rev. 4, S5-2-5462 Rev. 10, S5-2-6907 Rev. 0, S5-2-7737 Rev. 0 **Gap Analysis** Discretionary Gap. The installed design for most of the Inlet and discharge HEPA filters of the gloveboxes in 772-F does not permit In-Place Leak Testing.	**DOE-HNBK-1169 (2.3.8), ASME AG-1, ASME N510, SRS Engineering Standard 15888**
Instrumentation required to support system operability is calibrated.	The CVS(s) instrumentation are included in the F/H Labs IPI program in accordance with 1Q QAP 12-2. Instruments are calibrated periodically as driven by the IPI database. M&TE is used for all instrument calibrations. **Gap Analysis** No Gap.	**DOE-HNBK-1169 (2.3.8), ASME AG-1, ASME AG-1**
Integrated system performance testing is specified and performed.	The ventilation system performance testing is continuously demonstrated during normal system operation. Integrated system testing is not required for this system by the DSA. However system performance is tested and demonstrated during normal operation. **Gap Analysis** No Gap.	**DOE-HNBK-1169 (2.3.8)**

Evaluation Criteria	Discussion	Reference
	9 – Maintenance	
Filter service life program should be established.	The HEPA filter service life program for the FH Laboratories conforms to the SRS program governed by ENG-STD-15888. For the 772-F ventilation systems, this program is implemented via the Computerized Maintenance Management System (Passport). The filter service life program ensures that filters are tested prior to installation and periodically during service. Additionally this program ensures that the filters with a shelf life equal to or greater than 3 years are not installed and that filters are periodically replaced on a specified schedule. **Reference** L4 02-00021 Rev. 8, Filter Program, FH Labs **Gap Analysis** No Gap.	**DOE-HNBK-1169 (3.1 & App C), SRS Engineering Standard 15888**
	10 - Single Failure	
Backup electrical power shall be provided to all critical instruments and equipment required to operate and monitor the confinement ventilation system.	The 772-F CVS(s) are supplied with an alternate power supply (e.g. standby diesel generator). The ventilation systems and standby diesel generators are not credited in the DSA to perform any safety function during a loss of normal power event. Standby power is included in a larger set of worker safety features that provides defense-in-depth. **References** E-E2-F-2857 **Gap Analysis** Discretionary Gap – Electrical cables are run in open cable trays from 772-4F over the middle of the 772-F roof to the 254-9F diesel generator located on the west side of 772-F. A detonation event would potentially damage these cables and standby power capability to the 772-4F ventilation system could be lost.	**DOE-HNBK-1169 (2.2.7)**
	11 - Other Credited Functional Requirements	
Address any specific functional requirements for the confinement ventilation system (beyond the scope of those above) credited in the DSA.	The 772-F Main Exhaust, 772-F Off Gas Exhaust, and 772-4F Main Exhaust systems active CVS functions are not required but passive confinement by these CVS's are credited in the DSA. **References** WSRC-SA-96-26, Rev. 4 Central Laboratory Facility Buildings 772-F, 772-1F, and 772-4F Safety Analysis Report **Gap Analysis** No Gap.	**10 CFR 830, Subpart B**

Attachment 4 – F& H Area Laboratories Facility Evaluation Team

Billy Hudson – DOE-SR, AMWDP/WDED, Safety System Oversite

Billy Hudson is a Nuclear Engineer in the Department of Energy – Savannah River Operations Office, Assistant Manager Nuclear Materials Stabilization Project, Nuclear Materials Engineering Division. He has 19 years of engineering experience in the nuclear field. He holds Bachelors of Nuclear and Mechanical Engineering from the Georgia Institute of Technology. His primary responsibilities include engineering and safety basis oversight for the F/H Laboratory (F/H Labs) facility. Additional responsibilities include Safety System Oversight of the safety systems for F/H Labs. Prior to joining DOE in 1992, Mr Hudson worked as an engineer at Newport News Shipbuilding on the Enterprise Refueling Project.

Timothy Gabriel - WSRC, FET Lead, F/H Laboratories Process Engineering

Timothy Gabriel has a Bachelor of Science in Mechanical Engineering from the University of South Carolina. He has worked at WSRC over 6 years in the areas of Facility Engineering Support for the F & H Area Laboratories. In this position, he is responsible for technical reviews, configuration control, USQs, environmental compliance reviews and protection of the facility design basis. Tim provides day-to-day engineering field support for the 772-F, 772-1F, and 772-4F Confinement Ventilation Systems. While working at SRS, Tim has been recognized in the area of Ventilation and filtration by invitation and participation on the WSRC Site Ventilation & Filtration Committee as a Subject Matter Expert.

Michael Patterson – WSRC, Lead, F/H Laboratories Cognizant Engineer

Michael Patterson has Sixteen years of engineering experience in the nuclear field. He has a Bachelor of Science degree in Mechanical Engineering from Rose-Hulman Institute of Technology. His employment at the Savannah River Site began in 1990 in the Reactor Re-start Division as a Cognizant Engineer with the Airborne Activity Confinement System. In 1992, he moved to FH Laboratories as part of Operations Engineering, then later as a Cognizant Engineer. In this position, he is responsible for technical reviews, configuration control, USQs, environmental compliance reviews and protection of the facility design basis. Mike provides day-to-day engineering field support for the 772-F and 772-1F HVAC Systems.

Michael Harmon – WSRC, F/H Laboratories Cognizant Engineer

Michael Harmon has a Bachelor of Science in Electrical Engineering from the University of South Carolina. He has worked at WSRC since 1989 with past experience including high and low voltage systems, controls, diesel generators, domestic water distribution power and controls, river water pump house power and controls, design and projects technical lead. His present assignments within the Lab include subject matter expert input to the site Senior Electrical Review Board and Electrical Design Authority Engineer for normal and standby power systems.

Jerome Roberts – WSRC, F/H Laboratories Cognizant Engineer

Jerome Roberts has been with the WSRC for over 23 years in various engineering positions. Jerome holds a Bachelor of Science in Mechanical Engineering and an active Professional Engineering License in the State of Georgia. For the last 18 years, he has been the cognizant engineer for the FH Laboratories. In this position, he is responsible for technical reviews, configuration control, USQs, environmental compliance reviews and protection of the facility design basis. Jerome provides day-to-day engineering field support for the 772-F, 772-1F, and 772-4F Confinement Ventilation Systems..

Ana Yaneza – WSRC, F/H Laboratories Cognizant Engineer

Ana Yaneza has a Bachelor of Science in Electrical Engineering from the Northrop University. She has worked at WSRC for 15 years in F/H Laboratories as a cognizant engineer in the areas of Fire Protection, Electrical Systems, Startup Testing, Instrumentation and Controls, Radiological Monitoring Equipment, and Communications. Prior to WSRC, she worked at Westinghouse Electric Corporation for 3 years as a tactical controls engineer for the Department of Defense Trident I and Trident II Missile Launching Systems.

Roy Beck – WSMS, Safety Analysis Engineer

Roy Beck has a Bachelor of Science degree in Chemistry and began his career at SRS with the DWPF facility as a chemist. Job responsibilities were shifted to Analytical Laboratories in F Area prior to transfer to WSMS as a Regulatory Programs Specialist. Current job responsibilities include Design Authority interface for analytical activities and management of Safety Basis document revisions for the Nuclear facilities and a Low Hazard chemical facility.

Baidya Roy– WSMS, Safety Analysis Engineer

Baidya Roy has a B.S., Mechanical Engineering, M.S., Engineering Mechanics, and a M.S., Environment & Waste Management. He has 35 years of professional and supervisory experience in safety analysis, risk and reliability studies, engineering design, analysis and startup/operational support of DOE and commercial nuclear power facilities.

At present serving as a senior safety professional. performing probabilistic risk analysis for nuclear facilities and deterministic analysis to quantify risks and reliability of systems and components Served as Senior Professional at SRS System Engineering with lead responsibility in several Reactor Restart and Spent Nuclear Fuel Projects. Served as lead engineer at Westinghouse Nuclear Technological Division with responsibility in the areas of seismic/DBA analysis, testing, qualification of electrical/mechanical safety systems for several commercial nuclear power plants. Served as manager in charge of field design and construction support at PNPP-1 (Philippines) and Vogtle Units 1 & 2 (Georgia). Member in ASME and ASTM Technical Committees; Registered Professional Engineer in the State of Massachusetts. Authored several technical publications in the fields of safety, stress, seismic and fluid systems analyses.

William Leschak – WSRC, Solid Waste Operations

William Leschak has a Bachelor of Science degree in Marine Science from the University of South Carolina. He has been employed at SRS since 1993 and currently works for Energy Solutions. Prior to working at SRS, he was employed by SC DHEC for 7 years in the environmental monitoring field. Current duties include serving as NQA-1 Certified Lead Auditor and performing the Cognizant Quality Function for Waste Management Area Projects activities.

SEPARATION

PAGE

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M&O-MDO-2007-00228
RSM Track #: 10095

MAY 31 2007

Mr. Carl A. Everatt, Director
Office of Safety and Quality Assurance
U. S. Department of Energy
Savannah River Operations Office
P.O. Box A
Aiken, SC 29808

Dear Mr. Everatt:

DNFSB 2004-2 Ventilation Implementation Final Report for Outside Facilities-H (OF-H)

References:

1. WSRC-SA-2001-00008, Revision 10, H-Canyon Safety Analysis Report, January 2007.
2. WSRC Memorandum M&O-MDO-2007-00139, from W.E. Harris to C.A. Everatt, "DNFSB 2004-2 Ventilation Implementation (Table 4.3) Outside Facilities H-Canyon".

This letter supersedes the previous Table 4.3 transmittal (Ref. 2) stating that a Table 5.1 (Ventilation System Performance Criteria) gap analysis would be performed, and transmits the final report of DNFSB Recommendation 2004-2, "Active Confinement Systems for the OF-H located at the Savannah River Site (SRS)" for Site Evaluation Team review and concurrence. This is in accordance with Department of Energy (DOE) guidance provided in "Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems," Revision 0, January 2006 (hereafter called the DOE guidance document). The Facility Evaluation Team (FET) has concurred with the information contained herein.

The H-Outside Facilities (OF-H) described herein are identified as Hazard Category 2. There are no credited Safety Class (SC) or Safety Significant (SS) Confinement Ventilation Systems (CVSs) associated with these facilities. There is a non-credited Recycle Vessel Vent (RVV) active CVS that draws a slight vacuum on each vessel and discharges to the sand filter. Although the facilities are located out of doors, the source term contained in the vessels is low. For all of the accident consequences identified for the OF-H in the H-Canyon SAR (Ref. 1), all of the unmitigated radiological consequences are below the Evaluation Guidelines (EGs) for the Maximally Exposed Offsite Individual (MOI) (25 rem) (bounding event: Transfer Error, 0.91 rem)and the Evaluation Criteria for the Co-Located Worker (CW) (100 rem) (bounding event: Criticality, 52 rem). Additionally, the unmitigated radiological consequences do not exceed the minimum EGs required to establish SS defense-in-depth controls to protect the collocated worker and offsite public as defined in WSRC E7 Manual, Procedure 2.25. The accident analysis does not require a CVS as a mitigator for any of the Design Basis Accidents (DBAs) since the unmitigated doses do not challenge the current control selection guidelines. Note that H-Canyon SAR accident

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consequences have not been calculated using current DOE Environmental Management (DOE-EM) Interim Guidance, but work is underway to revise the SARs to current guidance. For example, 50% meteorology was used for the CW instead of 95%, but Material at Risk (MAR) estimates may be overly conservative.

The DOE guidance document requires a functional review of the facility CVS using a system evaluation approach. Functional design and performance attributes are defined to provide a structured approach to the evaluation and to address a generic set of attributes potentially applicable to a CVS. The DOE guidance document requires a review of the Hazard Category 2 facilities Documented Safety Analysis (Ref. 1), and the generic performance criteria provided in the DOE guidance document to identify gaps in the ventilation system and/or safety basis documents.

With guidance from the Site Evaluation Team and the DOE-HQ Independent Review Panel, a Table 5.1 is not warranted for these facilities since there are no confinement structures and no CVSs at these facilities. The FET recommends no facility modifications at this time but that the Safety Basis upgrade, that is currently underway, identify if additional Safety Basis controls are warranted. This recommendation is based on the following:

- Radiological doses to the MOI and CW below minimum EGs required to establish SS controls per WSRC E7 Manual, Procedure 2.25.
- Significant cost of constructing a confinement structure and CVS for multiple OF-H facilities (A-Line Facility, General Purpose Evaporator Facility, and Segregated Solvent Facility).
- The SAR is currently being revised to comply with DOE-EM Interim Guidance, which may change many of the accident scenarios and consequences.

Facility Evaluation Team Concurrence:

TMSmith	5/31/07	R.A. Frushour	5/31/07
T. M. Smith DOE	Date	R. A. Frushour FET/H-Canyon Lead	Date

Sincerely,

[signature] for W.E. Harris, Jr.

W. E. Harris, Jr., Chief Engineer
H-Area Material Disposition Project

weh/rf

Att.

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c: J. C. Barnes, DOE-SR, 704-2H
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Savannah River Site
OF-H Facilities
DNFSB Recommendation 2004-2
Ventilation System Evaluation

Table of Contents

Definitions

Confinement	A building space, room, cell, glovebox, or other enclosed volume in which air supply and exhaust are controlled, and typically filtered.
Confinement System	The barrier and its associated systems (including ventilation) between areas containing hazardous materials and the environment or other areas in the facility that are normally expected to have levels of hazardous material lower than allowable concentration limits.
Hazard Category	Hazard Category is based on hazard effects of unmitigated release consequences to offsite, onsite and local workers.
Performance Category	A classification based on a graded approach used to establish the Natural Phenomena Hazard (NPH) design and evaluation requirements for structures, systems, and components required to supply air to, circulate air within, and remove air from a building/facility space by natural or mechanical means.
Ventilation System	The ventilation system includes the structures, systems, and components required to supply air to, circulate air within, and remove air from a building/facility space by natural or mechanical means.

Acronyms

BTT	Basin Transfer Tank
CVS	Confinement Ventilation System
CW	Co-Located Worker (100 meters)
DBA	Design Basis Accident
DF	Design Feature
DID	Defense-in-Depth
DNFSB	Defense Nuclear Facility Safety Board
DOE	Department of Energy
DSA	Documented Safety Analysis
EG	Evaluation Guideline
EUS	Enriched Uranium Storage
FET	Facility Evaluation Team
GP	General Purpose
HA	Hazard Analysis
LEU	Low Enriched Uranium
MAR	Material at Risk
MOI	Maximally Exposed Offsite Individual
NPH	Natural Phenomena Hazard
OF-H	H-Outside Facilities
rem	Roentgen Equivalent Man
RVV	Recycle Vessel Vent
SAR	Safety Analysis Report
SRS	Savannah River Site
SS	Safety Significant

Executive Summary

On December 7, 2004, the Defense Nuclear Facilities Safety Board (DNFSB) issued Recommendation 2004-2, Active Confinement Systems. Recommendation 2004-2 noted concerns with the safety system (Safety Class/Safety Significant) designation strategy utilized in several facilities to confine radioactive materials during or following accidents. The DNFSB main issue is that for the purpose of confining radioactive materials through a facility-level ventilation system, safety system designation should be based on the active safety function (forced air though a filter system) rather than reliance on a passive confinement system.

The Department of Energy (DOE) agreed to review all Hazard Category 2 and 3 defense nuclear facilities and developed a methodology to perform a system evaluation for the identified facilities. This confinement ventilation evaluation is for the H-Outside Facilities (OF-H) at the Savannah River Site (SRS). The evaluation was performed in accordance with the requirements of Ref. 3 (hereafter called the DOE guidance document).

Operations conducted in OF-H include general support for H-Canyon operations, principally for processing of irradiated/unirradiated fuels and targets. This process area is located in an open area east of the 221-H building. The term "Outside Facilities" is used to describe a wide variety of processes and utilities that are ancillary to the primary 200-H Area operations. The facilities described herein are identified as Hazard Category 2.

The DOE guidance document requires a functional review of the facility Confinement Ventilation System (CVS) using a system evaluation approach. Functional design and performance attributes are defined to provide a structured approach to the evaluation and to address a generic set of attributes potentially applicable to a CVS. The DOE guidance document requires a review of the Hazard Category 2 facilities Documented Safety Analysis (Ref. 1) and the generic performance criteria provided in the DOE guidance document (Ref. 3) to identify gaps in the ventilation system and/or safety basis documents.

There are no credited confinement structures and no credited CVS in OF-H, nor is any CVS required by the Safety Analysis Report (SAR) (Ref. 1) due to the low radiological doses associated with normal facility operation, as identified in Ref. 2. DSA controls (non-safety related) and the Criticality Safety Program (CSP) are adequate to prevent criticality events and addition of an active CVS would do little to mitigate the worker consequences. There is a non-credited Recycle Vessel Vent (RVV) active CVS that draws a slight vacuum on each vessel and discharges to the sand filter. With guidance from the Site Evaluation Team and the DOE-HQ Independent Review Panel, a Table 5.1 evaluation is not warranted.

None of the OF-H accidents result in unmitigated consequences that exceed the offsite evaluation guidelines or onsite evaluation criteria. Note that H-Canyon and HB-Line SAR accident consequences have not been calculated using current DOE Environmental Management (DOE-EM) Interim Guidance, but work is underway to revise the SARs to current guidance. For example, 50% meteorology was used for the Co-located Worker (CW) instead of 95%, but Material at Risk (MAR) estimates may be overly conservative.

Based upon the low radiological doses to the Maximally Exposed Offsite Individual (MOI) and CW, the high cost of constructing a confinement structure and CVS for multiple facilities (A-Line Facility, General Purpose Evaporator Facility, and the Segregated Solvent Facility [reference Figure 1]), and the current work to revise the SAR consequences per DOE-EM Interim Guidance, the FET believes there is little benefit in constructing a CVS for any of the OF-H facilities and recommends that no modifications be made at this time but that the Safety Basis upgrade, that is currently underway, identify if additional Safety Basis controls are warranted.

1. Introduction

1.1 Facility Overview

H-OUTSIDE FACILITIES

The OF-H are located in the 200-H Separations Area and are comprised of a number of processes, utilities, and services that support the separations function. The OF-H provide general support, principally to the processing of irradiated/unirradiated fuels and targets in Building 221-H. The term "Outside Facilities" is used to describe a wide variety of processes and utilities that are ancillary to the primary 200-H Area operations. The OF-H processes include A-Line, General Purpose Evaporation, Segregated Solvent facilities, and Enriched Uranium Storage (EUS) Tank. Low Level Waste containers (e.g., Sealands, B-25s, B-12s, roll pans, and pot boxes) are also temporarily stored or staged at OF-H in support of H-Canyon activities. (Reference Figure 1 for the general facility diagram.)

A-LINE

The H-Area A-Line receives a dilute aqueous uranyl nitrate product solution enriched in U-235 from H-Canyon. The uranyl nitrate solution is stored in A-Line and the EUS Tank. A-Line is comprised of stainless steel storage and loading tanks and various pipes, pumps, valves, and other equipment by which uranyl nitrate product solutions are transferred, mixed, and stored. The primary purpose of the EUS Tank is to provide additional storage for approximately 163,000 gallons of liquid uranyl nitrate solution transferred from H-Canyon and A-Line tanks. The EUS Tank is used to store uranium solution that requires further purification and off-specification Low Enriched Uranium (LEU). (Reference Figure 1 for the location of A-Line Facility.)

GENERAL PURPOSE EVAPORATOR

The General Purpose (GP) Evaporator concentrates low-level radioactive alkaline aqueous wastes. The principal GP system components are an evaporator, a preheater and associated feed, hold, and storage tanks. The GP Evaporator, a flash evaporator, operates under reduced pressure with forced bottoms circulation. Concentrates are pumped to the Waste Tank Farm; condensates are pumped to holding tanks for disposal in the Effluent Treatment Project. (Reference Figure 1 for location of the GP Evaporator.)

SEGREGATED SOLVENT FACILITIES

The Solvent Recovery process removes degradation products and radioactive contaminants from spent solvent, neutralizes alkalinity from entrained carbonate wash, and returns the treated solvent to the extraction process. Principal equipment items are six tanks. Three tanks receive acid wash solution from Cold Feed Preparations, mix it with used solvent, then separate the solvent allowing it to overflow to a hold tank. Clean solvents are pumped back to the canyon for reuse, and wash solutions are pumped to the water handling facility for treatment or disposal. (Reference Figure 1 for location of the Segregated Solvent Facilities.)

1.2 Confinement Ventilation System/Strategy

There are no credited active or passive CVSs associated with these facilities. There is a non-credited RW active CVS that draws a slight vacuum on each vessel and discharges to the sand filter. Although the facilities are located out of doors, the source term contained in the vessels is low. The consequence and frequency analysis demonstrates that depleted and blended uranium solution storage, process and shipping containers, and other OF-H operations pose no undue risk to the public, the facility or onsite workers and the environment. The offsite Evaluation Guidelines and onsite evaluation criteria are not challenged for any of the bounding accidents in Attachment 1.

1.3 Major Modifications

There are no Major Modifications currently underway or planned for these facilities.

2. Functional Classification Assessment

2.1 Existing Classification

There are no credited active CVSs in the OF-H. There is a non-credited RVV active CVS that draws a slight vacuum on each vessel and discharges to the sand filter.

2.2 Evaluation

There are no credited SS or SC CVSs associated with these facilities. There is a non-credited RVV active CVS that draws a slight vacuum on each vessel and discharges to the sand filter. Although the facilities are located out of doors, the source term is low. The consequence and frequency analysis demonstrates that depleted and blended uranium solution storage, process and shipping containers, and other OF-H operations pose no undue risk to the public, the facility or onsite workers and the environment.

2.3 Summary

Due to low radiological doses for the OF-H facilities, there are no credited SS or SC CVSs. DSA controls (non-safety related) and the Criticality Safety Program (CSP) are adequate to prevent criticality events and addition of an active CVS would do little to mitigate the worker consequences. There is a non-credited RVV active CVS that draws a slight vacuum on each vessel and discharges to the sand filter. The unmitigated radiological consequences are low and do not exceed the minimum EGs (bounding events: Criticality, 52 rem for CW, and Transfer Error, 0.91 rem for MOI) required to establish Safety Significant (SS) defense-in-depth controls to protect the offsite public as defined in WSRC E7 Manual, Procedure 2.25.

The Hazard Analysis (HA) identified various events that were further evaluated as Design Basis Accidents (DBAs) in the SAR (Ref. 1). The DBAs include: natural phenomena, loss of confinement, explosion, external impact, fire, and criticality. The accident analysis does not require a CVS as a mitigator for any of the DBAs since the low unmitigated doses do not challenge the current control selection guidelines.

3. System Evaluation

3.1 Identification of Gaps

The DOE guidance document (Ref. 3) requires a functional review of the facility CVS using a system evaluation approach. Functional design and performance attributes are defined to provide a structured approach to the evaluation and to address a generic set of attributes potentially applicable to a CVS. The DOE guidance document requires a review of the Hazard Category 2 facilities SAR (Ref. 1), and the generic performance criteria provided in the DOE guidance document to identify gaps in the ventilation system and/or safety authorization basis documents.

With guidance from the Site Evaluation Team and the DOE-HQ Independent Review Panel, a Table 5.1 evaluation is not warranted. There are no credited confinement structures and no credited active CVSs due to the low radiological doses associated with facility operation as identified in Ref. 2 (Attachment 1).

3.2 Gap Evaluation

For OF-H, there are no credited building structures and no credited CVSs to evaluate. There is a non-credited RVV active CVS that draws a slight vacuum on each vessel and discharges to the H-Canyon sand filter and exhaust stack. The H-Canyon SAR (Ref. 1) accident consequences have not been calculated using current DOE-EM Interim Guidance, but work is underway to revise the SAR to current guidance. For example, 50% meteorology was used for the CW instead of 95%, but MAR estimates may be overly conservative. The MAR in the consequence analysis provides additional conservatism to indicate that the actual consequences will be much lower than those reported in the SAR accident consequence analysis. Consistent with the previous Table 4.3 submittal for OF-H (Ref. 2), unmitigated radiological doses to the public and on-site receptors are below offsite evaluation guidelines and onsite evaluation criteria.

The OF-H are located out of doors because the source term contained in the vessels is low. Due to low unmitigated radiological doses, the OF-H facilities operate without a credited confinement structure and without a credited CVS. Dikes are provided around the vessels to prevent runoff of normally encountered leaks and spills, and to mitigate the consequences of spills that are possible during severe natural phenomena. Therefore, risks to the surrounding environment are low. Fissile material concentrations are kept well below those necessary to achieve a nuclear criticality.

Design Features (DFs) include the B Basins (located entirely below grade) and the F1-6 Basin, which contain spilled liquid and prevent a release pathway to surface water. The materials of construction (strength) of the vessels at OF-H are a DF as well as the passive vents such as the vessel overflow lines, which are SS DFs that serve as escape outlets for pressure or liquid buildup in the tanks. The double-walled stainless steel EUS Tank is qualified to PC-3 NPH conditions and is equipped with a conservation vent.

The non-credited RVV system is an active CVS that maintains a vacuum on each vessel and discharges to the credited H-Canyon 294-H and 294-1H Sand Filters and the 291-H Exhaust Stack. One of the two RVV exhaust fans is in standby and automatically starts if the online exhaust fan fails or if the vacuum in the RVV header drops below limits. The RVV system functions automatically. In the event of failure of the RVV system, the GP Evaporator is shut down according to normal procedure. Other Building 211 operations that involve handling contaminated solutions are stopped and the canyon supervisor is notified. The exhaust fans are connected to the Building 292 emergency power system.

3.3 Modifications and Upgrades

Based upon the low radiological doses to MOI and CW, the high cost of constructing a confinement structure and CVS for multiple facilities (A-Line Facility, General Purpose Evaporator Facility, and the Segregated Solvent Facility), and since the SAR is currently being revised to DOE-EM Interim Guidance, the FET recommends that no modifications be made to the OF-H at this time but that the Safety Basis upgrade, that is currently underway, identify if additional Safety Basis controls are warranted.

4. Conclusion

For all of the accident consequences identified in the SAR for the OF-H Facilities, all of the unmitigated radiological consequences are below the EGs for the MOI (25 rem) and the CW (100 rem). Additionally, the unmitigated radiological consequences do not exceed the minimum EGs required to establish SS defense-in-depth controls to protect the collocated worker and offsite public as defined in WSRC E7 Manual, Procedure 2.25. The accident analysis does not require a CVS as a mitigator for any of the DBAs since the unmitigated doses do not challenge the current control selection guidelines. The consequence and frequency analysis demonstrates that depleted and blended uranium solution storage, process and shipping containers, and other OF-H operations pose no undue risk to the public, the facility or onsite workers and the environment. Note that H-Canyon and HB-Line SAR accident consequences have not been calculated using current DOE-EM Interim Guidance, but work is underway to revise the SARs to current guidance. For example, 50% meteorology was used for the CW instead of 95%, but MAR estimates may be overly conservative.

The safety analysis of OF-H and related support facilities indicates that the operation of these facilities to support the current and planned missions does not present undue risk to the general public, site workers, facility workers, or the environment.

5. References

1. WSRC-SA-2001-00008, Revision 10, H-Canyon Safety Analysis Report, January 2007.
2. WSRC Memorandum M&O-MDO-2007-00139, from W.E. Harris to C.A. Everatt, "DNFSB 2004-2, Ventilation Implementation (Table 4.3) Outside Facilities H-Canyon"
3. Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006 and the "2004-2 Ventilation System Evaluation Guidance Addendum", March 6, 2007.

Attachment 1

DNFSB Recommendation 2004-2 Table 4.3

OF-H Ventilation System Data Collection Table

Attachment 1 - 2004-2 Table 4.3, OF-H Ventilation System Data Collection Table

ATTACHMENT 1

Confinement Documented Safety Analysis Information										
Outside Facilities H-Area				Hazard Category 2				Performance Expectations		
Bounding Accidents [1]	Type Confinement		Doses Bounding unmitigated / mitigated [2]	Confinement Classification			Function	Functional Requirements	Performance Criteria	Compensatory Measures
	Active	Passive		SC	SS	DID				
Natural Phenomena-Earthquake.[5] (A.2.5.1)			Unmitigated [3, 4] MOI = 0.39 rem CW = 0.75 rem				No credit is taken for confinement in this scenario.	None	None	None
Natural Phenomena-Tornado.[6] (A.2.5.2)			Unmitigated [3, 4] MOI = 0.35 rem CW = 0.44 rem				No credit is taken for confinement in this scenario.	None	None	None
Loss of Confinement-Transfer Error to Outside Facilities. (8.3.2.5.1)			Unmitigated [4, 8] MOI = 0.91 rem CW = 7.8 rem		Note 7		No credit is taken for confinement in this scenario.	None	None	None
Loss of Confinement-Overflow of EUS Tank. (A.2.5.3)			Unmitigated [3, 4] MOI = 0.039 rem CW = 0.1 rem				No credit is taken for confinement in this scenario.	None	None	None

Attachment 1 - 2004-2 Table 4.3, OF-H Ventilation System Data Collection Table

Confinement Documented Safety Analysis Information										
Outside Facilities H-Area				Hazard Category 2				Performance Expectations		
Bounding Accidents [1]	Type Confinement		Doses Bounding unmitigated / mitigated [2]	Confinement Classification			Function	Functional Requirements	Performance Criteria	Compensatory Measures
	Active	Passive		SC	SS	DID				
Hydrogen Deflagration. [9] (A.2.5.4)			Unmitigated [3,4] MOI = 0.17 rem CW = 9.4 rem				No credit is taken for confinement in this scenario.	None	None	None
External Impact-EUS Tank. [10] (A2.5.5)			Unmitigated [3,4] MOI = 0.039 rem CW = 0.1 rem				No credit is taken for confinement in this scenario.	None	None	None
Fire-A-Line Large Fire. (A.2.5.6)			Unmitigated [3,4] MOI = 0.2 rem CW = 21 rem				No credit is taken for confinement in this scenario.	None	None	None
Fire-Solvent Fire. (A.2.5.6)			Unmitigated [3,4] MOI = 0.0052 rem CW = 0.52 rem				No credit is taken for confinement in this scenario.	None	None	None

Attachment 1 - 2004-2 Table 4.3, OF-H Ventilation System Data Collection Table

Confinement Documented Safety Analysis Information											
Outside Facilities H-Area				Hazard Category 2				Performance Expectations			
Bounding Accidents [1]	Type Confinement		Doses Bounding unmitigated / mitigated [2]	Confinement Classification			Function	Functional Requirements	Performance Criteria	Compensatory Measures	
	Active	Passive		SC	SS	DID					
Criticality- OF-H Sump. (A.2.5.7)			<u>Unmitigated</u> [3, 4] MOI = 0.00039 rem CW = 52 rem				No credit is taken for confinement in this scenario.	None	None	None	

Attachment 1 - 2004-2 Table 4.3, OF-H Ventilation System Data Collection Table

Notes:

1. The Bounding Accidents were identified from section A.2.5 (Accident Consequences) and Section 8.3.2, (Dominant Accident Scenario Descriptions) in the H-Canyon SAR.

2. MOI – Maximally Exposed Offsite Individual; CW – Collocated Worker (100 meters).

3. Doses taken from H-Canyon SAR, Table ES-3, (Outside Facilities H-Area Risk Summary). The CW consequence analysis is based on a 50% meteorology source term. These facilities now fall under the interim guidance; therefore, 95% meteorology will be addressed in the Documented Safety Analysis (DSA) upgrade for the CW.

4. Both the mitigated and unmitigated doses are the same. No credit is taken for controls to reduce the unmitigated doses.

5. For all systems except the Basin Transfer Tanks (BTT), it is assumed that 50% of the released liquid reaches the surface water system, with the remaining 50% forming a pool and contributing to a resuspension source term. Since the B-Basins are entirely below grade, there is no release to surface water for this system.

6. Because the B- Basins are below grade, the B-Basin tanks are not included in the DBT release scenario.

7. The engineered controls that mitigate the consequences of a transfer error to Outside Facilities are the B-Basins and the F1-6 Basin, which contain the spilled liquid. The B-Basins and F1-6 Basins prevent liquid releases to the waterways.

8. Doses taken from H-Canyon SAR, Table ES-2, (H-Canyon Risk Analysis Summary). The CW consequence analysis is based on a 50% meteorology source term. These facilities now fall under the interim guidance; therefore, 95% meteorology will be addressed in the DSA upgrade for the CW.

9. The dose from a hydrogen deflagration will bound all other deflagration accidents.

10. The bounding case for an external impact accident is a tank rupture causing 100% of the EUS Tank contents to be discharged to the pad. The dose from an external impact into the EUS Tank will bound all other external impacts into any other A-Line Tank, sample return trailers, or the Hanford Containers for the offsite receptor (H-Canyon SAR, Addendum 2, Section A.2.5.5, External Impact).

Attachment 2

Facility Evaluation Team Composition and Biographical Sketches

R.A. Frushour – WSRC FET H-Canyon Lead Engineer

Dick Frushour has a Bachelor of Science Degree in Mechanical Engineering. He has 32 years experience at SRS in process engineering, project engineering, facility maintenance, and safety basis maintenance. He has been assigned to H-Canyon Engineering since 1997 and has worked closely with the H-Canyon safety basis since 2002. He provides engineering support for writing, revising, and implementing the H-Canyon Safety Basis.

K. D. Scaggs – WSRC FET H-Canyon Ventilation Systems Engineer

Kyle Scaggs has a Bachelor of Science Degree in Mechanical Engineering from Clemson University in 1986. He has 12 years experience at SRS in systems engineering and as a construction liaison engineer and facility HVAC Coordinator. He has been assigned to H-Canyon Engineering as a ventilation systems engineer since 1998 and has served on several ventilation system upgrade project teams.

B. Ronald (Ron) Moncrief - WSRC, M&O Engineering, Senior Technical Advisor

Ron Moncrief has a Bachelor of Mechanical Engineering from the Georgia Institute of Technology and has over 40 years of engineering experience at SRS. His experience includes mechanical design, project management, and all aspects of H&V engineering. He currently is an SRS subject matter expert for H&V. He serves as Vice Chairman of the SRS Ventilation and Filtration Standards Committee and contributed to SRS Standard 15889, Confinement Ventilation Systems Design Criteria. He currently is Secretary and voting member of the Nuclear Subcommittee of the Industrial Air Conditioning Technical Committee TC 9.2 in the American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) and contributed to the ASHRAE publication, HVAC Design Guide for DOE Nuclear Facilities. He also serves as Secretary of the Instruments and Measurements Technical Committee TC 1.2 in ASHRAE.

D. E. Welliver – WSMS H-Area Disposition Regulatory Programs

Dave Welliver has a Bachelor of Science Degree in Chemical Engineering. He has 15 years experience working at various DOE facilities (principally SRS) with safety basis development, implementation and maintenance. He has been assigned to H-Area Disposition (H-Canyon and HB-Line) Regulatory Programs since 2006, managing the development and maintenance of H-Canyon and HB-Line safety bases.

List of Figures

FIGURE 1

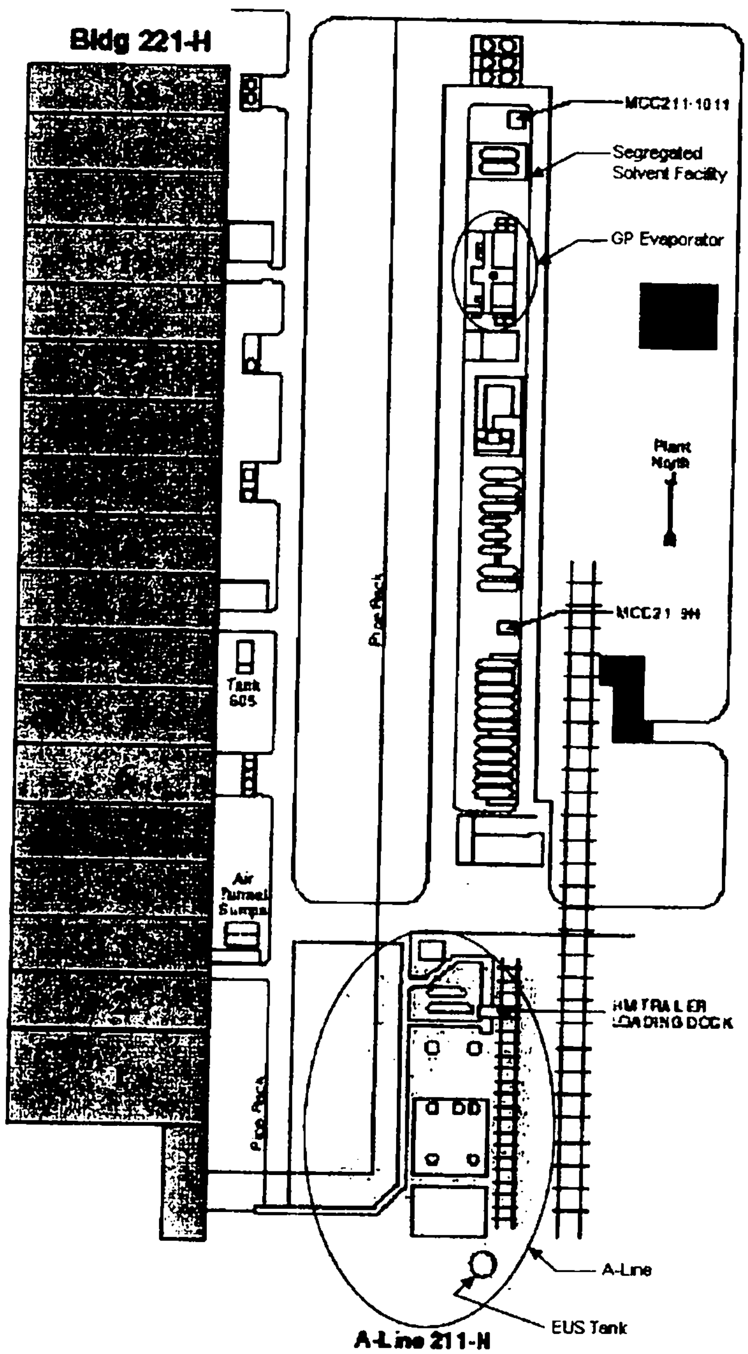

Figure 1

H-Area, A-Line, Building 211-H Facility

SEPARATION

PAGE

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M&O-SFP-2007-00090
RSM Track # 10277

Mr. Carl A. Everatt, Director
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U. S. Department of Energy
Savannah River Operation Office
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DNFSB 2004-2 VENTILATION SYSTEM EVALUATION FINAL REPORT FOR THE L MATERIAL STORAGE FACILITY DISASSEMBLY BASIN SECTION

Ref: WSRC-SA-2004-00002, Rev. 2 - *L Material Storage Area Documented Safety Analysis Report, 7/07*

This letter transmits the Final Report of the Defense Nuclear Facility Safety Board (DNFSB) Recommendation 2004-2, Active Confinement Systems for the L Area Material Storage Facility to the Department of Energy (DOE). Per "Recommendation 2004-2: Facility Ventilation System Evaluations Priority Listing", only the Disassembly Fuel Storage (Disassembly Basin) section of the L Reactor facility is required to be included in the L Area Material Storage Facility evaluation. No other sections of the facility such as heavy water storage, low level waste or deionizers are included.

The L Area Material Storage Facility (MSF) has been identified as a Hazard Category 2 facility. The Disassembly Basin (DB) section of the facility has both underwater and dry storage of spent nuclear fuel. There is no confinement ventilation system (CVS) for the underwater fuel storage or for the dry fuel storage in the DB. The primary ventilation fan for the DB is out of service and inoperable. This fan and any associated equipment are not credited as a mitigator or a preventor for any accidents identified in the L Area Material Storage Facility Documented Safety Analysis (DSA). Other credited Safety Class (SC) and Safety Significant (SS) controls either prevent or reduce the mitigated onsite and offsite dose to negligible (<5.0 rem for onsite and <0.5 rem for offsite) for all accidents except for criticality accidents. Criticality accident doses are reduced to low (<25.0 rem) for the onsite worker and negligible (<0.5 rem) for the public.

The Department of Energy (DOE) guidance document requires a functional review of the facility CVS using a system evaluation approach. Functional design and performance attributes are defined to provide a structured approach to the evaluation and to address a generic set of attributes potentially applicable to a CVS. The DOE guidance document requires a review of the Hazard Category 2 facilities Documented Safety Analysis (Ref. 1) and the generic performance criteria provided in the DOE guidance document to identify gaps in the ventilation system and/or safety basis documents.

With guidance from the Site Evaluation Team and the DOE-HQ Independent Review Panel, a Table 5.1 gap analysis is not warranted and was not completed for the L Area Material Storage Facility Disassembly Basin section since there is currently no CVS installed. The Facility Evaluation Team

(FET) recommends no facility modifications at this time. This recommendation is based on the following:

- With current credited controls in place, radiological doses to the worker and to the public are significantly below minimum Evaluation Guides (EGs) required to establish additional safety significant or safety class controls per WSRC E7 Manual, Procedure 2.25, Functional Classification.
- The significant cost of providing a confinement structure and CVS for the DB.
- Additional controls could be developed to reduce the consequences to the facility (onsite) worker in a criticality accident.

There were no inadequacies in the Material Storage Facility Documented Safety Analysis discovered during this evaluation.

A rough order of magnitude estimate for a generic General Service (GS) classification CVS has been completed. This CVS would provide no significant dose reduction to the already negligible consequences to the public in a criticality accident, but would possibly lower the low consequences to the facility worker in the same accident. The cost range of the generic GS CVS for the Disassembly Basin using an estimate prepared by Site Estimating is $20,000,000 (-30%/+50%).

Facility Evaluation Team Concurrence:

S. C. DeClue Department of Energy	9/24/2007 Date	W. E. Petty L Material Storage Area Lead	9/24/07 Date

Sincerely,

D. B. Rose, Chief Engineer
Spent Fuel Project

wep/mwp
Att.

c:
M. A. Smith, DOE-SR, 730-B
S. C. DeClue, 704-L
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R. D. Faris, WSMS, 704-26L
SFP Files, 704-L
Records Administration, 773-52A

Savannah River Site
L Material Storage Facility Disassembly Basin
DNFSB Recommendation 2004-2
Ventilation System Evaluation

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Definitions

Confinement	A building space, room, cell, glovebox, or other enclosed volume in which air supply and exhaust are controlled, and typically filtered.
Confinement System	The barrier and its associated systems (including ventilation) between areas containing hazardous materials and the environment or other areas in the facility that are normally expected to have levels of hazardous material lower than allowable concentration limits.
Hazard Category	Hazard Category is based on hazard effects of unmitigated release consequences to offsite, onsite and local workers.
Ventilation System	The ventilation system includes the structures, systems, and components required to supply air to, circulate air within, and remove air from a building/facility space by natural or mechanical means.

Acronyms

AHU	Air Handler Unites
CVS	Confinement Ventilation System
DB	Disassembly Basin
DFSA	Dry Fuel Storage Area
DNFSB	Defense Nuclear Facilities Safety Board
DOE	Department of Energy
DSA	Documented Safety Analysis
EG	Evaluation Guideline
FET	Facility Evaluation Team
GS	General Services
IRP	Independent Review Panel
ITC	Instrumented Test Canisters
MAR	Material at Risk
MSF	Material Storage Facility
SC	Safety Class
SET	Site Evaluation Team
SNF	Spent Nuclear Fuel
SS	Safety Significant

Executive Summary

On December 7, 2004, the Defense Nuclear Facilities Safety Board (DNFSB) issued Recommendation 2004-2, Active Confinement Systems. Recommendation 2004-2 noted concerns with the safety system (Safety Class/Safety Significant) designation strategy utilized in several facilities to confine radioactive materials during or following accidents. The DNFSB main issue is that for the purpose of confining radioactive materials through a facility level ventilation system, safety system designation should be based on the active safety function (forced air though a filter system) rather than reliance on a passive confinement system.

The DOE agreed to review all Hazard Category 2 and 3 defense nuclear facilities and developed a methodology to perform a system evaluation for the identified facilities. This confinement ventilation evaluation is for the Disassembly Basin section of the L Material Storage Facility at the Savannah River Site (SRS). The evaluation was performed in accordance with the requirements of Ventilation System Evaluation Guidance for Safety-Related and Non-Safety Related Systems, Revision 0, January 2006.

The DOE guidance document requires a functional review of the facility Confinement Ventilation System (CVS) using a system evaluation approach. Functional design and performance attributes are defined to provide a structured approach to the evaluation and to address a generic set of attributes potentially applicable to a CVS. The DOE guidance document requires a review of the Hazard Category 2 facilities DSA and the generic performance criteria provided in the DOE guidance document to identify gaps in the ventilation system and/or safety basis documents.

The L Area Material Storage Facility (MSF) has been identified as a Hazard Category 2 facility. The DB section has been modified and now primarily serves as a storage location for spent nuclear fuel, with dry and underwater storage of fuel. There is no CVS for the underwater fuel storage or for the dry fuel storage in the DB. There is no CVS credited as a mitigator or a preventor for any accidents identified in the L Area Material Storage Facility Documented Safety Analysis (DSA). Other credited Safety Class (SC) and Safety Significant (SS) controls either prevent or reduce the mitigated onsite and offsite does to negligible for all accidents except for criticality accidents. Those doses are reduced to low for the onsite worker and negligible for the public by the credited controls.

With guidance from the Site Evaluation Team (SET) and the DOE-HQ Independent Review Panel (IRP), a Table 5.1 gap analysis is not warranted and was not completed for the L Area Material Storage Facility Disassembly Basin section since there is currently no CVS installed and maximum gaps exist for all performance criteria. The FET recommends no facility modifications at this time. This recommendation is based on the following:

- With current credited controls in place, radiological doses to the worker and to the public are significantly below minimum EGs required to establish additional safety significant or safety class controls per WSRC E7 Manual, Procedure 2.25, Functional Classification.
- Significant cost of providing a confinement structure and CVS for the DB.

- Additional controls could be developed to further reduce the low consequences to the facility worker in a criticality accident.

There were no inadequacies in the Material Storage Facility Documented Safety Analysis discovered during this evaluation.

A rough order of magnitude estimate for a generic General Service (GS) classification CVS has been completed. This CVS would provide no dose reduction to the already negligible consequences to the public in a criticality accident, but would possibly lower the low consequences to the facility worker in the same accident. The cost range of the generic GS CVS for the Disassembly Basin using an estimate prepared by Site Estimating is $20,000,000 (-30%/+50%).

1. Introduction

1.1 Facility Overview

The L Area Material Storage Facility was originally known as L Reactor Facility. The facility began operation as a production reactor in the early 1950s, and operated until it was shut down in 1968, when its production capacity was not needed. The L Reactor was restarted in 1985 and again shutdown in 1988. In 1990, the decision was made to use the L Reactor Facility as a backup source of tritium production. In 1993, DOE directed WSRC to place the L Reactor in a shut-down condition with no capability for restart. In the mid 1990s, the L Facility MSF was directed to begin the receipt and storage of Foreign Research Reactor Fuel and Domestic Research Reactor Fuel in the DB section of the facility. By laying up equipment not associated with the ongoing storage and handling operations, potential hazards associated with the Material Storage Facility were reduced.

The DB section has been modified and now primarily serves as a storage location for spent nuclear fuel. The Savannah River Site plans to continue receiving spent nuclear fuel from research reactors and other miscellaneous nuclear material and storing it in the DB section until alternative interim storage facilities are available or final disposition of the material can be accomplished.

Typical activities performed at the L Area DB section include:

- Receipt, store, assay, handle and/or ship non fissile SRS reactor components, research reactor fuel, radiological material, and irradiated and unirradiated scrap underwater in the disassembly basin
- Handle Special Nuclear Material in the DB area and store dry in the Dry Fuel Storage Area (DFSA) and in the Dry Cave
- Receive and ship spent fuel casks
- Perform varied cask handling tasks
- Stage and handle waste generated by the facility

The majority of the fuel stored in the DB section is stored underwater. A small quantity of fuel is stored dry in the DFSA and in the Dry Cave. The DFSA is a totally enclosed, isolated area within the DB for the dry storage of fuel. The DFSA was designed as a critically safe and environmentally sound location for the dry storage of special nuclear material. The DFSA provides an effective four hour fire rated barrier wall. The Dry Cave is a partially enclosed, isolated area within the Disassembly Basin. The Dry Cave contains two Instrumented Test Canisters (ITCs). Each canister contains one assembly and has the capability to provide temperature, pressure and gaseous concentration data.

1.2 Confinement Ventilation System/Strategy

The purpose of the ventilation system in the DB section is to provide personnel comfort. The DSA does not have a requirement to maintain the DB at a negative pressure with respect to the outside environment or to provide either controlled or filtered releases to the environment. The EP 918 fan was used in years past to provide the air circulation in the MSF. The EP 918 is out of service. Active ventilation is not operable in the DB. Personnel cooling is provided by five air handler units (AHU) installed in the DB. These AHUs only cool and recycle DB air and provide no confinement function. The EP 918 fan is not credited as a mitigator or a preventor for any accidents identified in the L Area Material Storage Facility DSA. The confinement strategy for the facility is provided by the credited SC and SS controls in place in the DB.

1.3 Major Modifications

There are no major modifications planned for the MSF ventilation system. Recently, the EP 918 fan was taken out of service.

2. Functional Classification Assessment

2.1 Existing Classification

There are no credited active CVS in the DB.

2.2 Evaluation

The purpose of the ventilation system in the DB section is to provide personnel comfort. The DSA does not have a requirement to maintain the DB at a negative pressure with respect to the outside environment or to provide either controlled or filtered releases to the environment. Active ventilation is not operable in the DB. The EP 918 fan is not credited as a mitigator or a preventor for any accidents identified in the L Area Material Storage Facility DSA. All equipment associated with the DB ventilation system is classified as General Services (GS). Passive ventilation is provided by external access doors (which may be open or closed) in the Transfer Bay area of the DB and through exterior ventilation openings. Passive ventilation and the exterior ventilation openings are initial conditions assumed in the Hazards Analysis section of the DSA or in supporting calculations. These initial conditions are utilized to determine the intensity of a fire in the Disassembly Area. Passive ventilation is not credited as a preventor or a mitigator in the L-Area DSA. All equipment associated with passive ventilation is also classified as GS. There is also ventilation equipment located in the DB that is used for personnel heating and cooling. This equipment is also not credited in the DSA and is classified as GS.

The DB section of the facility has both underwater and dry storage and handling of spent nuclear fuel. Confinement is not credited as a mitigator or a preventor for any accidents identified in the L Area Material Storage Facility DSA. The Material at Risk (MAR) in the DB section includes Spent Nuclear Fuel (SNF) stored underwater in the DB, SNF staged in casks above water in the transfer bay, SNF stored above water in the Dry Cave and Dry Fuel Storage Area, as well as the basin water and basin sludge. Events were postulated in the DSA for fires, explosions, loss of confinement, direct shine, criticality, external hazards, and Natural Phenomena Hazards. Existing credited controls include the disassembly basin structure, pump suction break, basin water, disassembly area structure, dry fuel storage area fire barrier, Area Radiation Monitors, emergency response procedures for basin water makeup, combustible controls, fuel casks, dry fuel storage container, limited building footprint, and fuel handling procedures. With the existing credited controls these postulated releases do not challenge offsite radiological evaluation guidelines or onsite criteria.

With the above controls in place radiological releases from the DB Section for all the postulated DSA events except one will either be prevented or mitigated with negligible consequences. Those prevented events include a fire or explosion releasing radionuclides from the underwater fuel, a fuel melt initiated by loss of water over the fuel, release of radionuclides in the basin sludge, a fire induced criticality or radiological release from SNF stored inside the dry fuel storage area, a process or fire induced in-air criticality, or a radiological release from a spent fuel cask initiated by a fire or explosion. Those mitigated events with negligible consequences include a release of the radionuclides from the basin water, the nuclear material stored in the dry cave, material in a cask, or a single dry fuel storage container staged outside of the DFSA. The one exception is an underwater criticality. If this event occurred the water above the criticality would substantially reduce the consequence. The 12 rad zone would be located under water. The water also scrubs the gases but some fission product gases are released. The Area Radiation Monitors are designed to alarm and provide an early warning to alert the facility workers to evacuate the area. Workers are trained to stop work immediately and to proceed directly away from the alarm location. As shown in the DSA the consequence to the offsite public would be negligible. Consequences onsite would be low to the co-located worker and facility worker. Additional controls could be developed to further reduce the consequences to the co-located and the facility worker.

The current consequence analysis for the Spent Fuel Project utilizes 50% meteorology onsite and 95% meteorology offsite. The current DOE interim guidance requires that facilities, such as those found in SFP, recalculate Safety Basis consequences that involve new or revised consequence calculations using the higher meteorology and then present a recommendation to DOE. SFP activities involving new or revised consequence calculations will include the interim guidance.

2.3 Summary

There is no confinement ventilation system for the underwater fuel storage or for the dry fuel storage in the DB. No CVS equipment is credited as a mitigator or a preventor for any accidents identified in the L Area Material Storage Facility DSA. Other credited SC and SS controls reduce the mitigated onsite and offsite does to negligible for all accidents except for criticality accidents. These doses are reduced to low for the onsite worker and negligible for the public.

Since no active or passive equipment associated with DB ventilation is credited in the DSA, the equipment is appropriately functionally classified as General Services.

3. System Evaluation

3.1 Identification of Gaps

The DOE guidance document requires a functional review of the facility CVS using a system evaluation approach. Functional design and performance attributes are defined to provide a structured approach to the evaluation and to address a generic set of attributes potentially applicable to a CVS. The DOE guidance document requires a review of the Hazard Category 2 facilities DSA and the generic performance criteria provided in the DOE guidance document to identify gaps in the ventilation system and/or safety authorization basis documents.

Guidance from the SET and the DOE-HQ IRP concluded that a Table 5.1 evaluation is not required for the DB. There is no credited active CVS installed for the DB due the other controls in place to reduce the consequences of the postulated facility accidents. If the Table 5.1 Performance Criteria Evaluation was performed, it would show the widest possible gaps in all of the evaluation areas.

3.2 Gap Evaluation

The credited controls for the operation of the DB as summarized above and as included in the DSA provide adequate protection for the facility worker, the co-located worker and the public. The addition of an active confinement system for the Disassembly basin section is not warranted to further reduce the consequences of any postulated accidents.

For events that have either been prevented and mitigated or have negligible consequences, the addition of a ventilation system to mitigate the release would have insignificant benefit. Current controls in place reduce the consequences of postulated events to below EGs. To further mitigate the already low consequences of an underwater criticality by the use of a CVS would be difficult. To build such a system would be impractical. Major modifications would be required to an area of the facility that was not originally designed for confinement. Fission product gasses released during a criticality would emanate from the water filled basin. A ventilation system that would have ductwork overhead would exhaust the gasses past the operators at the scene and would not substantially mitigate an exposure as the gases are removed. Any reduction of consequences would be minimal. Exhaust ductwork installed at water level would hamper normal operations and is not a viable alternative. For the facility worker gases escaping from the basin would have to be removed.

The current postulated dose to the co-located worker is low from a criticality accident. There are currently no programmatic controls (emergency preparedness, evacuation, etc.) in place to mitigate the dose to the co-located worker. Although the dose to the co-located worker could be reduced by the installation of a CVS, simpler more cost effective means could be utilized to reduce the dose.

3.3 Modifications and Upgrades

Since there is no existing CVS in the DB, major facility modifications would have to be completed to provide any confinement capabilities in the DB. The DB is fortified to provide security, but it is not designed as a sealable confinement structure. A rough order of magnitude estimate was developed to provide a General Services classified CVS for the DB. Existing controls reduce the consequences of all accidents below the EG at which a SC or SS CVS would be required for further dose reduction. The GS system included in the estimate provides an idea of the cost and level of effort required to provide any CVS for the DB. Further development of the confinement strategy for the DB and Safety Basis work may show that a SC or SS system would be required, but the generic GS system does provide a starting point for the cost and impact.

The estimate summary sheets provide details of a CVS which includes:

- Fan(s)
- Ductwork
- Electrical Supply
- Instrumentation
- Costs to Seal the DB for Confinement
- A Stack
- Site Preparations
- Testing
- Site Overheads, Labor Costs and Contingencies

The cost range of the CVS for the Disassembly Basin using an estimate prepared by Site Estimating is $20,000,000 (-30%/+50%). This estimate does not include safety basis work, fire analysis work, procedures, training or numerous other areas that would be affected. No schedule for design, construction and testing was developed, but is it reasonable to assume that the L-Area core business of cask receipts and fuel storage would experience many delays and the programs would be impacted as the CVS was installed.

The potential reduction in doses due to the installation of the CVS in the DB was not quantified for this report. The only accident where the CVS would possibly reduce doses is to the facility worker in the underwater criticality; all other accidents are prevented or mitigated below EGs with existing controls. Since the mitigated doses to the facility worker for this accident are low, no additional SC or SS controls are required. The CVS in the DB would be considered an additional GS system that would further reduce the already low doses from this accident. Additional controls could be developed to accomplish an equivalent dose reduction. The CVS is not needed in the DB.

4. Conclusion

There is no active confinement system for the underwater or for the dry fuel storage in the DB. Active ventilation is not credited as a mitigator or a preventor for any accidents identified in the L Area Material Storage Facility DSA. The credited controls for the operation of the DB as summarized above and as included in the DSA provide adequate protection for the facility worker, the co-located worker and the public. The addition of an active confinement system for the Disassembly Basin section is not warranted to further reduce the consequences of any postulated accidents.

5. References

1. WSRC-SA-2004-00002, Rev. 2 - L Material Storage Area Documented Safety Analysis Safety Analysis Report, 7/07

2. WSRC Memorandum M&O-SFP-2007-00022, Revision 1, from D. B. Rose to C.A. Everatt, "Transmittal of Spent Fuel Project DNFSB Recommendation 2004-2 Active Confinement Systems Table 4.3 Evaluation"

Att. 1 - 2004-2 Table 4.3, Disassembly Basin Underwater Fuel Storage Ventilation System Data Collection Table

Ventilation System Evaluation Guidance											
L Reactor Material Storage Facility, Underwater Storage			Hazard Category 2				Performance Expectations				
Bounding	Type Confinement		Doses Bounding Unmitigated/Mitigated (Onsite Worker 1, Onsite Worker 2, Offsite Receptor)	Confinement Classification			Function	Functional Requirements	Performance Criteria	Compensatory Measures
	Active	Passive		SC	SS	DID				
Fire in the disassembly basin section that causes a criticality. DB-1b	Ventilation is not credited in the DSA to provide confinement	Ventilation is not credited in the DSA to provide confinement	High, Moderate, Negligible/Prevented	NA	NA	NA	There are no ventilation functions credited in the DSA	There are no ventilation functional requirements credited in the DSA	There are no ventilation performance criteria credited in the DSA	There are no ventilation compensatory measures credited in the DSA
Fire in the disassembly basin transfer bay that causes a criticality. DB-1c	Ventilation is not credited in the DSA to provide confinement	Ventilation is not credited in the DSA to provide confinement	High, Moderate, Negligible/Prevented	NA	NA	NA	There are no ventilation functions credited in the DSA	There are no ventilation functional requirements credited in the DSA	There are no ventilation performance criteria credited in the DSA	There are no ventilation compensatory measures credited in the DSA
Tractor, truck or train fire in transfer bay. DB-3	Ventilation is not credited in the DSA to provide confinement	Ventilation is not credited in the DSA to provide confinement	High, High, Low/Negligible, Negligible, Negligible	NA	NA	NA	There are no ventilation functions credited in the DSA	There are no ventilation functional requirements credited in the DSA	There are no ventilation performance criteria credited in the DSA	There are no ventilation compensatory measures credited in the DSA
Explosion in transfer bay during fuel loading or unloading. DB-9	Ventilation is not credited in the DSA to provide confinement	Ventilation is not credited in the DSA to provide confinement	High, High, High/Negligible, Negligible, Negligible	NA	NA	NA	There are no ventilation functions credited in the DSA	There are no ventilation functional requirements credited in the DSA	There are no ventilation performance criteria credited in the DSA	There are no ventilation compensatory measures credited in the DSA

Att. 1 - 2004-2 Table 4.3, Disassembly Basin Underwater Fuel Storage Ventilation System Data Collection Table

Basin draindown from filtration/deionizer system leakage. DB-15	Ventilation is not credited in the DSA to provide confinement	Ventilation is not credited in the DSA to provide confinement	High, High, High/High, High, Prevented	NA	NA	NA	There are no ventilation functions credited in the DSA	There are no ventilation functional requirements credited in the DSA	There are no ventilation performance criteria credited in the DSA	There are no ventilation compensatory measures credited in the DSA
Airborne SNF and liquid release from basin draindown. DB-24	Ventilation is not credited in the DSA to provide confinement	Ventilation is not credited in the DSA to provide confinement	High, High, High/Prevented	NA	NA	NA	There are no ventilation functions credited in the DSA	There are no ventilation functional requirements credited in the DSA	There are no ventilation performance criteria credited in the DSA	There are no ventilation compensatory measures credited in the DSA
Criticality in disassembly basin due to fuel handling, etc. DB-32, DB-33, DB-34, DB-37, DB-38, DB-39, DB-42, DB-43, DB-44	Ventilation is not credited in the DSA to provide confinement	Ventilation is not credited in the DSA to provide confinement	High, Moderate, Negligible/Low, NA, NA	NA	NA	NA	There are no ventilation functions credited in the DSA	There are no ventilation functional requirements credited in the DSA	There are no ventilation performance criteria credited in the DSA	There are no ventilation compensatory measures credited in the DSA
Criticality in disassembly basin due to fuel handling, etc. DB-35, DB-36, DB-40, DB-41, DB-45, DB-46	Ventilation is not credited in the DSA to provide confinement	Ventilation is not credited in the DSA to provide confinement	High, Moderate, Negligible/ Prevented	NA	NA	NA	There are no ventilation functions credited in the DSA	There are no ventilation functional requirements credited in the DSA	There are no ventilation performance criteria credited in the DSA	There are no ventilation compensatory measures credited in the DSA
Criticality in disassembly basin due to fuel handling, etc. DB-44b	Ventilation is not credited in the DSA to provide confinement	Ventilation is not credited in the DSA to provide confinement	High, Moderate, Negligible/ Prevented	NA	NA	NA	There are no ventilation functions credited in the DSA	There are no ventilation functional requirements credited in the DSA	There are no ventilation performance criteria credited in the DSA	There are no ventilation compensatory measures credited in the DSA

Att. 1 - 2004-2 Table 4.3, Disassembly Basin Underwater Fuel Storage Ventilation System Data Collection Table

Radiological release due to external fire. DB-51	Ventilation is not credited in the DSA to provide confinement	Ventilation is not credited in the DSA to provide confinement	High, High, High/Negligible, Negligible, Negligible Mitigated consequences are similar to DB-1	NA	NA	NA	There are no ventilation functions credited in the DSA	There are no ventilation functional requirements credited in the DSA	There are no ventilation performance criteria credited in the DSA	There are no ventilation compensatory measures credited in the DSA
Release of radiological material from disassembly basin due to large aircraft crash. DB-54	Ventilation is not credited in the DSA to provide confinement	Ventilation is not credited in the DSA to provide confinement	High, High, High/NA, NA, NA	NA	NA	NA	There are no ventilation functions credited in the DSA	There are no ventilation functional requirements credited in the DSA	There are no ventilation performance criteria credited in the DSA	There are no ventilation compensatory measures credited in the DSA
Release of radiological material from disassembly basin due to small aircraft crash. DB-55	Ventilation is not credited in the DSA to provide confinement	Ventilation is not credited in the DSA to provide confinement	High, High, High/NA, NA, NA	NA	NA	NA	There are no ventilation functions credited in the DSA	There are no ventilation functional requirements credited in the DSA	There are no ventilation performance criteria credited in the DSA	There are no ventilation compensatory measures credited in the DSA
Seismic event damage permits loss of basin water. DB-63	Ventilation is not credited in the DSA to provide confinement	Ventilation is not credited in the DSA to provide confinement	High, High, High/ Prevented	NA	NA	NA	There are no ventilation functions credited in the DSA	There are no ventilation functional requirements credited in the DSA	There are no ventilation performance criteria credited in the DSA	There are no ventilation compensatory measures credited in the DSA

Notes:

1. NA (Not Applicable) in the dose column means that the doses for that accident, after the frequency or preventive/mitigative features were considered, were sufficiently low that no further evaluation was warranted.

2. All of the GE (General) accidents were omitted for this section because the dominate material at risk for the GE accidents is the heavy water stored in the facility. The heavy water is not included in the CVS evaluation.

3. The events in the Table 4.3 are given a high, moderate, low or negligible unmitigated consequence for the onsite worker 1, onsite worker 2 and the offsite receptor. Table 3.3-8 of the DSA quantifies the radiological consequence levels for the different hazard receptors as follows:

Att. 1 - 2004-2 Table 4.3, Disassembly Basin Underwater Fuel Storage Ventilation System Data Collection Table

Consequence Level	Offsite Receptor Consequences	Onsite Worker #1 Consequences (Inside the facility)	Onsite Worker #2 Consequences (Outside the facility)
High	Greater than or equal to 25.0 rem	Prompt worker fatality, acute injury that is life threatening or permanently disabling or consequences greater than or equal to 100 rem	Consequences greater than or equal to 100 rem or prompt worker fatality, acute injury that is life threatening or permanently disabling
Moderate	Consequence greater than or equal to 5.0 rem and less than 25.0 rem	Serious injury, no immediate loss of life, no permanent disabilities or consequences greater than or equal to 25 rem and less than 100 rem	Consequences greater than or equal to 25 rem and less than 100 rem or serious injury, no immediate loss of life, no permanent disabilities
Low	Consequence greater than or equal to 0.5 rem and less than 5.0 rem	Minor injuries, no hospitalization and consequences greater than or equal to 5 rem and less than 25 rem	Consequences greater than or equal to 5 rem and less than 25 rem or minor injuries, no hospitalization
Negligible	Consequence less than 0.5 rem	Consequences less than Low levels and less than 5.0 rem	Less than 5.0 rem and consequences less than Low levels

Att. 1 - 2004-2 Table 4.3, Disassembly Basin Underwater Fuel Storage Ventilation System Data Collection Table

Ventilation System Evaluation Guidance										
L Reactor Material Storage Facility, Underwater Storage			Hazard Category 2				Performance Expectations			
Bounding	Type Confinement		Doses Bounding Unmitigated/Mitigated (Onsite Worker 1, Onsite Worker 2, Offsite Receptor)	Confinement Classification			Function	Functional Requirements	Performance Criteria	Compensatory Measures
	Active	Passive		SC	SS	DID				
Fire in the disassembly basin section that causes a criticality. DB-1b	Ventilation is not credited in the DSA to provide confinement	Ventilation is not credited in the DSA to provide confinement	High, Moderate, Negligible/Prevented	NA	NA	NA	There are no ventilation functions credited in the DSA	There are no ventilation functional requirements credited in the DSA	There are no ventilation performance criteria credited in the DSA	There are no ventilation compensatory measures credited in the DSA
Fire in the disassembly basin transfer bay that causes a criticality. DB-1c	Ventilation is not credited in the DSA to provide confinement	Ventilation is not credited in the DSA to provide confinement	High, Moderate, Negligible/Prevented	NA	NA	NA	There are no ventilation functions credited in the DSA	There are no ventilation functional requirements credited in the DSA	There are no ventilation performance criteria credited in the DSA	There are no ventilation compensatory measures credited in the DSA
Tractor, truck or train fire in transfer bay. DB-3	Ventilation is not credited in the DSA to provide confinement	Ventilation is not credited in the DSA to provide confinement	High, High, Low/Negligible, Negligible, Negligible	NA	NA	NA	There are no ventilation functions credited in the DSA	There are no ventilation functional requirements credited in the DSA	There are no ventilation performance criteria credited in the DSA	There are no ventilation compensatory measures credited in the DSA
Explosion in transfer bay during fuel loading or unloading. DB-9	Ventilation is not credited in the DSA to provide confinement	Ventilation is not credited in the DSA to provide confinement	High, High, High/Negligible, Negligible, Negligible	NA	NA	NA	There are no ventilation functions credited in the DSA	There are no ventilation functional requirements credited in the DSA	There are no ventilation performance criteria credited in the DSA	There are no ventilation compensatory measures credited in the DSA

Att. 1 - 2004-2 Table 4.3, Disassembly Basin Underwater Fuel Storage Ventilation System Data Collection Table

Basin draindown from filtration/deionizer system leakage. DB-15	Ventilation is not credited in the DSA to provide confinement	Ventilation is not credited in the DSA to provide confinement	High, High, High/High, High, Prevented	NA	NA	NA	There are no ventilation functions credited in the DSA	There are no ventilation functional requirements credited in the DSA	There are no ventilation performance criteria credited in the DSA	There are no ventilation compensatory measures credited in the DSA
Airborne SNF and liquid release from basin draindown. DB-24	Ventilation is not credited in the DSA to provide confinement	Ventilation is not credited in the DSA to provide confinement	High, High, High/Prevented	NA	NA	NA	There are no ventilation functions credited in the DSA	There are no ventilation functional requirements credited in the DSA	There are no ventilation performance criteria credited in the DSA	There are no ventilation compensatory measures credited in the DSA
Criticality in disassembly basin due to fuel handling, etc. DB-32, DB-33, DB-34, DB-37, DB-38, DB-39, DB-42, DB-43, DB-44	Ventilation is not credited in the DSA to provide confinement	Ventilation is not credited in the DSA to provide confinement	High, Moderate, Negligible/Low, NA, NA	NA	NA	NA	There are no ventilation functions credited in the DSA	There are no ventilation functional requirements credited in the DSA	There are no ventilation performance criteria credited in the DSA	There are no ventilation compensatory measures credited in the DSA
Criticality in disassembly basin due to fuel handling, etc. DB-35, DB-36, DB-40, DB-41, DB-45, DB-46	Ventilation is not credited in the DSA to provide confinement	Ventilation is not credited in the DSA to provide confinement	High, Moderate, Negligible/ Prevented	NA	NA	NA	There are no ventilation functions credited in the DSA	There are no ventilation functional requirements credited in the DSA	There are no ventilation performance criteria credited in the DSA	There are no ventilation compensatory measures credited in the DSA
Criticality in disassembly basin due to fuel handling, etc. DB-44b	Ventilation is not credited in the DSA to provide confinement	Ventilation is not credited in the DSA to provide confinement	High, Moderate, Negligible/ Prevented	NA	NA	NA	There are no ventilation functions credited in the DSA	There are no ventilation functional requirements credited in the DSA	There are no ventilation performance criteria credited in the DSA	There are no ventilation compensatory measures credited in the DSA

Att. 1 - 2004-2 Table 4.3, Disassembly Basin Underwater Fuel Storage Ventilation System Data Collection Table

Radiological release due to external fire. DB-51	Ventilation is not credited in the DSA to provide confinement	Ventilation is not credited in the DSA to provide confinement	High, High, High/Negligible, Negligible, Negligible Mitigated consequences are similar to DB-1	NA	NA	NA	There are no ventilation functions credited in the DSA	There are no ventilation functional requirements credited in the DSA	There are no ventilation performance criteria credited in the DSA	There are no ventilation compensatory measures credited in the DSA
Release of radiological material from disassembly basin due to large aircraft crash. DB-54	Ventilation is not credited in the DSA to provide confinement	Ventilation is not credited in the DSA to provide confinement	High, High, High/NA, NA, NA	NA	NA	NA	There are no ventilation functions credited in the DSA	There are no ventilation functional requirements credited in the DSA	There are no ventilation performance criteria credited in the DSA	There are no ventilation compensatory measures credited in the DSA
Release of radiological material from disassembly basin due to small aircraft crash. DB-55	Ventilation is not credited in the DSA to provide confinement	Ventilation is not credited in the DSA to provide confinement	High, High, High/NA, NA, NA	NA	NA	NA	There are no ventilation functions credited in the DSA	There are no ventilation functional requirements credited in the DSA	There are no ventilation performance criteria credited in the DSA	There are no ventilation compensatory measures credited in the DSA
Seismic event damage permits loss of basin water. DB-63	Ventilation is not credited in the DSA to provide confinement	Ventilation is not credited in the DSA to provide confinement	High, High, High/ Prevented	NA	NA	NA	There are no ventilation functions credited in the DSA	There are no ventilation functional requirements credited in the DSA	There are no ventilation performance criteria credited in the DSA	There are no ventilation compensatory measures credited in the DSA

Notes:

1. NA (Not Applicable) in the dose column means that the doses for that accident, after the frequency or preventive/mitigative features were considered, were sufficiently low that no further evaluation was warranted.

2. All of the GE (General) accidents were omitted for this section because the dominate material at risk for the GE accidents is the heavy water stored in the facility. The heavy water is not included in the CVS evaluation.

3. The events in the Table 4.3 are given a high, moderate, low or negligible unmitigated consequence for the onsite worker 1, onsite worker 2 and the offsite receptor. Table 3.3-8 of the DSA quantifies the radiological consequence levels for the different hazard receptors as follows:

Att. 1 - 2004-2 Table 4.3, Disassembly Basin Underwater Fuel Storage Ventilation System Data Collection Table

Consequence Level	Offsite Receptor Consequences	Onsite Worker #1 Consequences (Inside the facility)	Onsite Worker #2 Consequences (Outside the facility)
High	Greater than or equal to 25.0 rem	Prompt worker fatality, acute injury that is life threatening or permanently disabling or consequences greater than or equal to 100 rem	Consequences greater than or equal to 100 rem or prompt worker fatality, acute injury that is life threatening or permanently disabling
Moderate	Consequence greater than or equal to 5.0 rem and less than 25.0 rem	Serious injury, no immediate loss of life, no permanent disabilities or consequences greater than or equal to 25 rem and less than 100 rem	Consequences greater than or equal to 25 rem and less than 100 rem or serious injury, no immediate loss of life, no permanent disabilities
Low	Consequence greater than or equal to 0.5 rem and less than 5.0 rem	Minor injuries, no hospitalization and consequences greater than or equal to 5 rem and less than 25 rem	Consequences greater than or equal to 5 rem and less than 25 rem or minor injuries, no hospitalization
Negligible	Consequence less than 0.5 rem	Consequences less than Low levels and less than 5.0 rem	Less than 5.0 rem and consequences less than Low levels

Att. 2 - 2004-2 Table 4.3, Disassembly Basin Dry Fuel Storage Ventilation System Data Collection Table

Ventilation System Evaluation Guidance											
L Reactor Material Storage Facility, Dry Storage			Hazard Category 2				Performance Expectations				
Bounding	Type Confinement		Doses Bounding Unmitigated/Mitigated (Onsite Worker 1, Onsite Worker 2, Offsite Receptor)	Confinement Classification			Function	Functional Requirements	Performance Criteria	Compensatory Measures
	Active	Passive		SC	SS	DID				
Unsafe geometry caused by fire results in criticality. DB-1d	Ventilation is not credited in the DSA to provide confinement	Ventilation is not credited in the DSA to provide confinement	High, Moderate, Negligible/ Prevented	NA	NA	NA	There are no ventilation functions credited in the DSA	There are no ventilation functional requirements credited in the DSA	There are no ventilation performance criteria credited in the DSA	There are no ventilation compensatory measures credited in the DSA
Unsafe geometry caused by fire results in criticality. DB-1e	Ventilation is not credited in the DSA to provide confinement	Ventilation is not credited in the DSA to provide confinement	High, Moderate, Negligible/Prevented	NA	NA	NA	There are no ventilation functions credited in the DSA	There are no ventilation functional requirements credited in the DSA	There are no ventilation performance criteria credited in the DSA	There are no ventilation compensatory measures credited in the DSA
Explosion in instrumented test container (ITC). DB-13	Ventilation is not credited in the DSA to provide confinement	Ventilation is not credited in the DSA to provide confinement	Low, Negligible, Negligible/NA, NA, NA	NA	NA	NA	There are no ventilation functions credited in the DSA	There are no ventilation functional requirements credited in the DSA	There are no ventilation performance criteria credited in the DSA	There are no ventilation compensatory measures credited in the DSA
Explosion near dry fuel. DB-13a	Ventilation is not credited in the DSA to provide confinement	Ventilation is not credited in the DSA to provide confinement	Low, Negligible, Negligible/NA, NA, NA	NA	NA	NA	There are no ventilation functions credited in the DSA	There are no ventilation functional requirements credited in the DSA	There are no ventilation performance criteria credited in the DSA	There are no ventilation compensatory measures credited in the DSA

Att. 2 - 2004-2 Table 4.3, Disassembly Basin Dry Fuel Storage Ventilation System Data Collection Table

Radiological release due to loss of confinement (ITCs). DB-27	Ventilation is not credited in the DSA to provide confinement	Ventilation is not credited in the DSA to provide confinement	Low, Negligible, Negligible/NA, NA, NA	NA	NA	NA	There are no ventilation functions credited in the DSA	There are no ventilation functional requirements credited in the DSA	There are no ventilation performance criteria credited in the DSA	There are no ventilation compensatory measures credited in the DSA
Radiological release due to loss of confinement (storage container). DB-27a	Ventilation is not credited in the DSA to provide confinement	Ventilation is not credited in the DSA to provide confinement	Low, Negligible, Negligible/NA, NA, NA	NA	NA	NA	There are no ventilation functions credited in the DSA	There are no ventilation functional requirements credited in the DSA	There are no ventilation performance criteria credited in the DSA	There are no ventilation compensatory measures credited in the DSA
Criticality in dry fuel handling areas due to fuel handling, etc. DB-40, DB-46, DB-50, DB-50b, DB-50c and DB-50e	Ventilation is not credited in the DSA to provide confinement	Ventilation is not credited in the DSA to provide confinement	High, Moderate, Negligible/Prevented	NA	NA	NA	There are no ventilation functions credited in the DSA	There are no ventilation functional requirements credited in the DSA	There are no ventilation performance criteria credited in the DSA	There are no ventilation compensatory measures credited in the DSA
Radiological release due to external fire. DB-51	Ventilation is not credited in the DSA to provide confinement	Ventilation is not credited in the DSA to provide confinement	High, High, High/ Negligible, Negligible, Negligible Mitigated consequences are similar to DB-1	NA	NA	NA	There are no ventilation functions credited in the DSA	There are no ventilation functional requirements credited in the DSA	There are no ventilation performance criteria credited in the DSA	There are no ventilation compensatory measures credited in the DSA
Radiological release due to large aircraft crash. DB-54	Ventilation is not credited in the DSA to provide confinement	Ventilation is not credited in the DSA to provide confinement	High, High, High/ Prevented	NA	NA	NA	There are no ventilation functions credited in the DSA	There are no ventilation functional requirements credited in the DSA	There are no ventilation performance criteria credited in the DSA	There are no ventilation compensatory measures credited in the DSA
Radiological release due to small aircraft crash. DB-55	Ventilation is not credited in the DSA to provide confinement	Ventilation is not credited in the DSA to provide confinement	High, High, High/NA, NA, NA	NA	NA	NA	There are no ventilation functions credited in the DSA	There are no ventilation functional requirements credited in the DSA	There are no ventilation performance criteria credited in the DSA	There are no ventilation compensatory measures credited in the DSA

Att. 2 - 2004-2 Table 4.3, Disassembly Basin Dry Fuel Storage Ventilation System Data Collection Table

Notes:

1. NA (Not Applicable) in the dose column means that the doses for that accident, after the frequency or preventive/mitigative features were considered, were sufficiently low that no further evaluation was warranted.

2. All of the GE (General) accidents were omitted for this section because the dominate material at risk for the GE accidents is the heavy water stored in the facility. The heavy water is not included in the CVS evaluation.

3. The events in the Table 4.3 are given a high, moderate, low or negligible unmitigated consequence for the onsite worker 1, onsite worker 2 and the offsite receptor. Table 3.3-8 of the DSA quantifies the radiological consequence levels for the different hazard receptors as follows:

Consequence Level	Offsite Receptor Consequences	Onsite Worker #1 Consequences (Inside the facility)	Onsite Worker #2 Consequences (Outside the facility)
High	Greater than or equal to 25.0 rem	Prompt worker fatality, acute injury that is life threatening or permanently disabling or consequences greater than or equal to 100 rem	Consequences greater than or equal to 100 rem or prompt worker fatality, acute injury that is life threatening or permanently disabling
Moderate	Consequence greater than or equal to 5.0 rem and less than 25.0 rem	Serious injury, no immediate loss of life, no permanent disabilities or consequences greater than or equal to 25 rem and less than 100 rem	Consequences greater than or equal to 25 rem and less than 100 rem or serious injury, no immediate loss of life, no permanent disabilities
Low	Consequence greater than or equal to 0.5 rem and less than 5.0 rem	Minor injuries, no hospitalization and consequences greater than or equal to 5 rem and less than 25 rem	Consequences greater than or equal to 5 rem and less than 25 rem or minor injuries, no hospitalization
Negligible	Consequence less than 0.5 rem	Consequences less than Low levels and less than 5.0 rem	Less than 5.0 rem and consequences less than Low levels

Attachment 3

Facility Evaluation Team Composition and Biographical Sketches

W. E. Petty – WSRC FET Spent Fuel Project Lead Engineer

Ed Petty has a Bachelor of Science Degree in Mechanical Engineering from the University of South Carolina. He has 28 years experience at SRS in operations, engineering, training and work planning. He has held positions in Reactor Operations, FB-Line Startup, H-Canyon Engineering and is currently assigned as the ventilation system engineer in Spent Fuel Projects in L-Area. Ed served as the lead for the Spent Fuel Project DNFSB 2004-2 efforts.

J. A. Guy – WSRC FET Spent Fuel Project Regulatory Engineering Manager

Jon Guy has a Bachelor of Nuclear Engineering from the University of Florida, Master of Mechanical Engineering from the University of South Carolina and has 17 years of engineering experience at SRS. His experience includes plant system engineering for rotating mechanical and electrical equipment, spent nuclear fuel handling and storage, regulatory programs and engineering management. He has held positions in the Savannah River Sites Reactor areas, the D-Area Heavy water facility and the F-Area Material Storage Facility. He currently is assigned to the Spent Fuel Project as the Regulatory Programs Engineering Manager.

Dr. S. C. DeClue – DOE FET Federal Project Director Spent Fuel

Dr. Scotty DeClue received his Doctorate of Education from NOVA Southeastern University, an MS in Engineering Management from the University of Alaska, and a BS in Chemical Engineering from the University of Missouri. He is a licensed Professional Engineer in South Carolina and has his Project Management Professional certification.

Dr. DeClue is the Federal Project Director for the Spent Fuel Project at Savannah River Site and is the Integrated Project Team Leader for the Spent Nuclear Fuel Transfer project. Previously, he served as a Facility Representative in H-Canyon, HB-Line, FB-Line, F-Canyon, 235-F, K-Area and L-Area. He has served as a team member for numerous facility assessments including the Nevada Test Site Transuranic Waste Storage Facility Readiness Assessment, the H-Canyon LEU Loadout Readiness Assessment, the HB-Line Phase II Readiness Assessment, the HB-Line Mixed Scrap Readiness Assessment, and oversight of the contractor's readiness assessments for K-Area Material Storage Phase II and the Americium/Curium Transfer to High Level Waste.

R.D. Faris – WSMS SFP Regulatory Lead

Robert Faris has a Bachelor of Mechanical Engineering degree from the Georgia Institute of Technology. He has over 31 years experience in the nuclear industry including 13 years associated with the nuclear power industry and 18 years associated with SRS. His experience includes diverse Engineering and Regulatory assignments. He has been involved in various aspects of spent fuel storage since 1997, and has lead the development, implementation, and maintenance of Spent Fuel Projects nuclear safety documents since 2001.

SEPARATION

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United States Government | Department of Energy (DOE)

memorandum

Savannah River Operations Office (SR)

DATE: NOV 0 2 2007

REPLY TO ATTN OF: TSD (Mark A. Smith, 803-952-9613)

SUBJECT: Request for Concurrence with Recommendation of the Defense Nuclear Facilities Safety Board (DNFSB) 2004-2 Final Report for the Savannah River Site (SRS) Solid Waste Management Facilities

TO: Dae Y. Chung, Deputy Assistant Secretary for Safety Management and Operations (EM-60), HQ

In accordance with the DNFSB 2004-2 Implementation Plan (IP) Deliverable 8.6.5, please find attached the DNFSB 2004-2 Final Report for the SRS Solid Waste Management Facilities. After completing the evaluation, SRS recommends that no facility modifications be made at this time based on the fact that current operations perform the opening of containers in a temporary radiological containment system. Also this recommendation is based on the fact that with current credited controls in place (a Technical Safety Requirement establishes a Safety Significant inventory limit), radiological doses to the worker and public are below the evaluation guidelines required to establish safety class or any additional safety significant controls. Finally, there is no active confinement ventilation system installed in the Solid Waste Management Facilities.

In accordance with IP deliverable 8.6.5, please provide Program Secretarial Officer concurrence with this recommendation within 90 days of receipt of this report.

If you have any questions, please contact Mark A. Smith at 803-952-9613.

Jeffrey M. Allison
Manager

TSD:MAS:dmy

OSQA-08-0010

Attachment:
2004-2 Final Report for Solid Waste Management Facilities

cc w/attachment:
Dr. Robert C. Nelson (EM-61), HQ
Percy Fountain (EM-3.2), HQ

SRS SITE EVALUATION TEAM CONCURRENCE
Final DNFSB 2004-2 Evaluation Report

Facility: **Solid Waste Management Facility.** WSRC Letter M&O-WMAP-2007-00068, "DNFSB 2004-2 Final Report Transmittal", dated 7/31/07

Reference:

1. Commitment 8.6.3 of DNFSB 2004-2 Implementation Plan Revision 1, dated July 12, 2006

2. Ventilation System Evaluation Guidance for Safety-Related and Non-Safety-Related Systems, dated July 2006, Revision 1.

In accordance with the references above, the SRS Site Evaluation Team has reviewed and concurs with the submittal of the attached Solid Waste Management Facility final report.

Site Evaluation Team (SET) Concurrence:

Signature on file — 10/25/07
Mark A. Smith, DOE-SR, Site Lead for SET — Date

Signature on file — 10/25/07
Ken W. Stephens, WSRC Lead for SET — Date

SRS Site Evaluation Team consists of the following personnel:

DOE Site Lead and SET Chairman (Mark A. Smith, OSQA/TSD)
DOE Alternate Site Lead & Safety Basis SME (Don J. Blake, AMWDP/WDED)
DOE Ventilation System and Natural Phenomena Hazards SME (Brent J. Gutierrez, AMWDP/WDED)
WSRC 2004-2 Site Lead Ken W. Stephens (TQS/Nuclear Safety, Transportation, and Engineering Standards Dept. Mgr.)
WSRC Alternate Site Lead & Safety Basis SME (Andrew M. Vincent, M&O Chief Engineer Dept.)
WSRC Ventilation System SME (Scott J. MacMurray, SRNL Facility Engineering)
WSMS Safety Basis SME (Jerry L. Hansen)
WSRC SET Assistant Project Manager (Barbara A. Pollard, Nuclear Safety Dept.)

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Mr. Carl A. Everatt, Acting Director
Office of Safety and Quality Assurance
Department of Energy
Savannah River Operations Office
P. O. Box A
Aiken, South Carolina 29802

071169

Dear Mr. Everatt:

DNFSB 2004-2 FINAL REPORT TRANSMITTAL

This letter transmits the final report for the N Area Solid Waste Management Facility (SWMF) Hazardous and Mixed Waste (HWMW) Storage Buildings as required by DNFSB Recommendation 2004-2, Active Confinement Ventilation Systems (CVS). SWMF Facility Evaluation Team concurrence is acknowledged in the final report. This transmittal is in accordance with the Department of Energy (DOE) guidance provided in "Ventilation System Evaluation Guidance for Safety Related and Non-Safety Related Systems", Revision 0, January 2006.

Sincerely,

W. A. Morrison, Deputy Manager
Waste Management Area Project

rtd/ccc
Att.
c: M. A. Mikolanis, DOE, 707-H
T. M. Tran, 707-H
T. C. Temple, 707-H
M. A. Smith, 730-B
D. D. McCormack, 730-B
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M. G. Looper, 704-36E
C. B. Stevens, 704-58E
P. N. Fairchild, 704-35E
R. D. Burns, 704-55E
J. J. Copeland, WSMS
S. J. Snyder, WSMS
WMAP Document Control, 642-E

Savannah River Site

Solid Waste Management Facilities

Hazardous and Mixed Waste Storage Buildings

Buildings 645-N, 645-2N and 645-4N

DNFSB Recommendation 2004-2

Ventilation System Evaluation

Revision 0

July 23, 2007

Review and Approval

Facility Evaluation Team Concurrence:

[signature]	7/31/07
Tam Tran, Lead, DOE Authorization Basis for SWMF	**Date**
[signature]	7/30/07
Roger Duke, Technical Advisor, WMAP Engineering	**Date**
[signature]	7/31/07
Steve Crook, Manager, WMAP Safety Compliance	**Date**
[signature]	7/30/07
Peter Fairchild, TRU Engineering Lead, WMAP	**Date**

Table of Contents

1.0 Acronyms

CHA – Consolidated Hazard Analysis
CVS – Confinement Ventilation System
CW – Co-located Worker
DNFSB – Defense Nuclear Facilities Safety Board
DOE – Department of Energy
DSA – Documented Safety Analysis
EG – Evaluation Guideline
GS – General Service
HC – Hazard Category
HEPA – High Efficiency Particulate Air
HW – Hazardous Waste
MAR – Material At Risk
MOI - Maximally-Exposed Offsite Individual
MPFL – Maximum Possible Fire Loss
MW – Mixed Waste
NPH – Natural Phenomena Hazard
PC – Performance Category
REM – Roentgen Equivalent Man
SC – Safety Class
SRS – Savannah River Site
SSC – Systems, Structures or Components
SWMF – Solid Waste Management Facilities
TPC – Total Project Cost
TRU – Transuranic

2.0 Definitions

Confinement – A building, building space, room, cell, glovebox, other enclosed volume in which air supply and exhaust are controlled and typically filtered.

Confinement System – The barrier and its associated systems (including ventilation) between areas containing hazardous materials and the environment or other areas in the facility that are normally expected to have levels of hazardous materials lower than allowable concentration limits.

Hazard Category – Hazard Category is based on hazard effects of unmitigated release consequences to offsite, onsite and local workers.

Performance Category – A classification based on a graded approach used to establish the Natural Phenomena Hazard design and evaluation requirements for structures, systems and components.

Ventilation System – The ventilation system includes the structures, systems and components required to supply air to, circulate air within, and remove air from a building/facility space by natural or mechanical means.

3.0 Executive Summary

This confinement ventilation evaluation is for the Savannah River Site (SRS) Solid Waste Management Facilities (SWMF) for the storage of hazardous and mixed waste(HWMW). Three N Area HWMW storage buildings, 645-N, 645-2N and 645-4N, are addressed in this evaluation. This evaluation was completed in accordance with the Department of Energy (DOE) evaluation guidance (EG) for Defense Nuclear Facility Safety Board (DNFSB) Recommendation 2004-2. These storage buildings currently have no installed active confinement ventilation systems (CVS) and there are no existing plans for systems to be installed.

The facilities collectively comprise a Hazard Category (HC) 3 segment. None of the buildings possess an active or passive airborne release confinement system. The facilities will be evaluated against Defense in Depth (DID) criteria to determine if there is a need for active confinement ventilation systems.

The draft SWMF DSA Upgrade analyzed the bounding accident (a combustible liquid fire) in Hazard Category 3 buildings 645-N, 645-2N and 645-4N. Inventory limits were established to control the onsite worker consequence to a level less than the onsite evaluation criteria. Any CVS subsequently installed in Buildings 645-N, 645-2N and 645-4N would therefore not be credited as either as Safety Class or Safety Significant. A CVS, if installed, would be credited only as a Defense in Depth design feature.

Three options are evaluated in this report. Option 1 includes the design and installation of CVSs in each of the three buildings. Option 2 includes the design and installation of a structure, similar to an existing Savannah River Site (SRS) Mixed Waste Processing Facility (MWPF), inside one of the N Area buildings with primary and secondary confinements. The designs of both options address all of the applicable criteria. Option 3 is current operations, which performs the opening of containers in a temporary radiological containment system.

The Total Project Cost (TPC) range of estimates for Options 1 and 2 are $7.8M-$16.8M and $1.8M-$3.8M, respectively. Adding a fire suppression system to each building could be as much as three times the cost depending on the choice of suppression technology. Both of these designs adequately mitigate the consequences of the bounding accident occurring inside the confinement areas. Option 3, which is to perform open container operations within a temporary radiological containment system, e.g., a ventilated plastic hut that meets WSRC 5Q requirements, is recommended by the Facility Evaluation Team rather than Option 1 or 2. The FET believes the low operational risk normally involved with open container processing does not justify the expense of either Options 1 or 2 and the low risk is appropriately managed by Option 3.

4.0 Introduction

4.a Facility Overview

As described in references 1 and 2, the three HWMW Storage Buildings (645-N, 645-2N, and 645-4N) are located within the plant northwest quadrant of N-Area. Each building has been permitted by the SCDHEC to provide interim storage of containerized Mixed Waste and/or Hazardous Waste, Low Level Waste, RCRA empty containers, TSCA waste, and non-hazardous waste. Again, the inventories in the buildings are maintained as Hazard Category 3. Buildings 645-N, 645-2N, and 645-4N are segregated into one or more cells (or bays) and are used to provide interim storage of waste in containers as specified in the current RCRA Permit. These vented metal buildings provide weather shelter for the waste containers. The containers are stored on concrete pads that have surface liquid containment curbs around each side.

Operation of the HWMW buildings includes the handling, sampling, storage, repackaging, lab packing, sorting, and inspection of hazardous waste and mixed waste containers. Only waste that meets the requirements of the WSRC Manual 1S WAC or have approved WAC deviations (Ref. 3) is received. Containers meeting the WAC are transported into the storage building, typically via forklift. The containers may then be re-palletized for space optimization and placed into the proper storage location as directed by the receipt procedure. Waste storage procedures do not permit incompatible wastes to be stored in the same cell. Hazardous and mixed wastes are stored within the buildings until shipped offsite.

4.b Confinement Ventilation Strategy

Buildings 645-N, 645-2N and 645-4N do not have a CVS installed. The current DOE-approved, implemented SWMF DSA and the draft SWMF DSA Upgrade have not identified the need for or credited a CVS to mitigate onsite or offsite radiological exposure consequences from accidents that may occur in 645-N, 645-2N and 645-4N. Radiological inventory is limited in these Hazard Category 3 buildings by the Technical Safety Requirements such that releases from these buildings due to accidents analyzed in the DSAs do not pose an undue risk to onsite workers or the public, i.e., offsite Evaluation Guides and onsite evaluation criteria specified in WSRC E7 Procedure 2.25 are not challenged.

4.c Major Modifications

Two options requiring major modifications are evaluated in this report. Option 1 includes the design and installation of CVSs in each of the three buildings. Option 2 includes the design and installation of a structure inside one of the N Area buildings with primary and secondary confinements. The design of each option addresses all of the applicable criteria.

5.0 Functional Classification Assessment

5.a Existing Classification

Buildings 645-N, 645-2N and 645-4N currently do not have a CVS. The following functional classification assessment will therefore consider the functional classification of any CVS that might be installed in any or all of these buildings in the future.

5.b Evaluation

This evaluation is based on the hazard and accident analysis results of the draft SWMF DSA Upgrade for Buildings 645-N, 645-2N and 645-54N. The draft DSA Upgrade analysis bounds that in the current DOE-approved and implemented SWMF DSA.

The draft DSA Upgrade analyzed a bounding combustible organic liquid fire in SWMF Hazard Category 3 facilities including the subject buildings. The fire scenario assumed that an entire Hazard Category 3 inventory was contained in a spilled combustible organic liquid that subsequently burns. The unmitigated event resulted in a dose to the 100-meter worker of 269 rem and an offsite dose to the Maximally-Exposed Offsite Individual (MOI) of 0.14 rem. Both the offsite and onsite (100-meter) doses were calculated using 95^{th} percentile meteorology. The MOI consequence did not challenge the offsite Evaluation Guide so no Safety Class preventative or mitigative controls were specified. The onsite worker dose, which exceeded the worker evaluation criteria, is mitigated to approximately 77 rem by a Technical Safety Requirement inventory limit, which serves a Safety Significant function. Since the TSR inventory limit reduced the worker consequence to less than the evaluation criteria, additional Safety Significant controls, such as a CVS, were not specified by the DSA accident analysis. Additional conservatisms that would further reduce the expected dose include the fact that individual waste containers stored in these buildings normally have a very low radiological content compared to the full Hazard Category 3 inventory authorized for these buildings cumulatively. In fact, since the waste in these buildings is typically bulk contaminated combustible liquid, the DSA Upgrade will limit these buildings to no more than 16 PEC each. Additionally, the DSA Upgrade will limit individual containers that could be opened within 645-N, -2N, and -4N to no more than 4 PEC. Thus, the 100-meter worker hazard from a fire involving one of these containers would be much less than the mitigated dose of 77 rem (approximately 20 rem). Dose mitigation would be further enhanced by SRS fire fighting and emergency response actions that would be initiated upon a fire.

If a CVS were to be installed in the subject buildings, it would serve a Defense in Depth safety function since the 100-meter worker has already been mitigated to less than the evaluation criteria. A CVS that utilizes HEPA filtration operating at 99.97% minimum efficiency would further reduce the worker dose to well below 1 rem, assuming that the CVS continues to operate during the fire accident. However, a DID CVS is not required to withstand a credible fire event according to the Ventilation System Evaluation Guidance (Ref. 5).

5.c Summary

The draft SWMF DSA Upgrade has analyzed the bounding accident (a combustible liquid fire) in Hazard Category 3 buildings 645-N, 645-2N and 645-4N and has established a Technical Safety Requirement inventory limit that will control the onsite worker consequence to a level less than the onsite evaluation criteria. Also, the unmitigated consequence to the MOI does not challenge the offsite Evaluation Guide. Any CVS subsequently installed in Buildings 645-N, 645-2N and 645-4N would therefore not be credited as either as Safety Class or Safety Significant. A CVS, if installed, would be credited only as a Defense in Depth design feature.

6.0 System Evaluation

6.a Identification of Gaps and Evaluation

As previously mentioned, Buildings 645-N, 645-2N and 645-4N currently do not have a CVS resulting in the submittal of Table 5.1 containing gaps for all of the criteria. As a result of being HC-3 facilities, Table 5.1 included applicable DID criteria. Two options were evaluated, both of which are designed and estimated to close all of the gaps. Option 1 included the design and installation CVSs in each of the three buildings. Option 2 includes the design and installation of a structure with primary and secondary confinements inside one of the buildings.

6.b Modification and Upgrades

Option 1 – New CVSs for Each Building

Each building has its own confinement ventilation system (CVS) designed to ensure the system and facility meet the DNFSB 2004-2 criteria in accordance with applicable requirements of DOE HDBK 1169-03, ASHRAE, and ASME AG-1 codes and standards. The systems prevent the spread of contamination by ventilating each building at the rate of 8 Air Changes per Hour (ACH). Each system operates continuously maintaining the building, which serves as the primary confinement zone, at the required negative pressure. A new 150KVA transformer will be required to provide adequate power for the new systems. All roof and wall openings are closed and sealed. Doors, single and rollup, are installed to support operations. Air enters the building through engineered openings and exhausts through grilles, ductwork and stack via High Efficiency Particulate Absolute (HEPA) filters of 99.97% efficiency. Duct and filter housing are fabricated from stainless steel. The HEPA filters are procured in accordance with SRS program requirements and designed for in-place testing. Appropriate instruments and alarms are installed to monitor differential pressure and airflow conditions. A new fan slab, stack foundation and duct supports are installed to support the installation of the HEPA filter housing, fan and stack assembly. For a summary description, see Attachment 3.

Option 1 - Cost Estimate (See Ref. 7)

A Rough-Order-of Magnitude (ROM) estimate to install a CVS in each building is:

Building	TPC	Low Range (-30%)	High Range (+50%)
645-N	$3.7M	$2.6M	$5.5M
645-2N	$4.0M	$2.8M	$6.1M
645-2N	$3.5M	$2.4M	$5.2M
Total	$11.2M	$7.8M	$16.8M

This CVS is not required by the Evaluation Guidance to meet the criterion for withstanding credible fire events. However, the analyzed accident scenario is a full facility fire. Since the building serves as the primary confinement zone for this option, it must be protected. According to the DOE HDBK-1169, Section 10 Fire Protection, a suppression system should be installed for each building to mitigate building and ductwork damage. In addition, the HEPA filters should be made of noncombustible materials with water sprays as required and a fire detection system installed in filter housings. Installing a fire suppression system in each of the buildings could increase the cost by as much as three times depending on the choice of suppression technology.

Option 2 - Mixed Waste Processing Facility Equivalent

This option includes the design and installation of a structure inside one of the N Area buildings with primary and secondary confinements. The design and estimate is based on the Mixed Waste Processing Facility (MWPF), which is currently installed on TRU Pad 6 in E-Area. It was designed for performing process activities including: sorting, segregating, characterizing and repackaging of waste. The MWPF is a category 3 facility with GS functional classification of equipment. The performance category for all SSCs is PC-1. The design of enclosures and equipment is such that it can be disassembled, moved and reassembled at another location on SRS.

The 100'x45' building contains both primary and secondary confinement zones with airlocks. The ventilation system was designed to meet the requirements of ERDA 76-21 and the ASHRAE Heating, Ventilation and Air Conditioning Design Guide for DOE Nuclear Facilities. Airflow through the primary and secondary confinement zones is filtered and exhausted. Differential pressures are maintained such that air moves from areas of lesser contamination to areas of greater contamination. Secondary confinement has four to six air changes/hour. Primary confinement has six to ten air changes/hour. The exhaust passes through HEPA filters located upstream of the ventilation exhaust fans. The HEPA filters contain enough capacity to handle the volume of air at a minimum filter efficiency of 99.97%. HEPA filters are nuclear grade and procured in accordance with SRS program requirements. The MWPF employs three ventilation exhaust fans, each with its own HEPA filter banks and ductwork. They are installed such that two can operate continuously while one is being serviced. Interlocks are provided for the supply and exhaust fans to prevent facility air reversals caused by failure of one or more of the exhaust fans. Differential pressure between confinements shall be measured with centrally located instruments. Gages on the secondary and any tertiary confinements shall be readable by personnel entering and operating in the space. Alarms are installed to alert personnel of fan and filter failures. Radioactivity, chemical concentrations and differential pressure are monitored and alarmed. For a summary description of the MWPF ventilation system, see Attachment 5.

Option 2 - Cost Estimate (See Ref. 8)

The MWPF TEC was estimated in 2001 at $1.5M. This estimate, adjusted for escalation to 2007 dollars and TPC, is $2.5M. Using this as the basis for Option 2, a Rough-Order-of Magnitude estimate to close all the gaps is: $1.8M to $3.8M (-30%/+50%).

The MWPF is designed to meet NFPA 801, Standard for Fire Protection for Facilities Handling Radioactive Materials. It is equipped with a combustible gas detection system, an automatic fire detection system and an alarm system. No additional costs are added to address the fire accident scenario.

Option 3 – Existing Operations

Existing operations to open containers is performed in a temporary radiological containment system, e.g., a ventilated plastic hut that meets WSRC 5Q requirements. Container opening operations are typically only infrequently performed (several operations per year) within the 645-N, 645-2N and 645-4N buildings. The likelihood of the waste material becoming involved in a fire during one of these infrequent operations would be very low as a result. Also, individual waste containers stored in these buildings normally have a very low radiological content compared to the full Hazard Category 3 inventory authorized for these buildings cumulatively. In fact, since the waste in these buildings is typically bulk contaminated combustible liquid, the DSA Upgrade will limit these buildings to no more than 16 PEC each. Additionally, the DSA Upgrade will limit individual containers that could be opened within 645-N, -2N, and -4N to no more than 4 PEC. Thus, the 100-meter worker hazard from a fire involving one of these containers would be much less than the mitigated dose of 77 rem (approximately 20 rem). Dose mitigation would be further enhanced by SRS fire fighting and emergency response actions that would be initiated upon a fire.

7.0 Conclusion

The Total Project Cost (TPC) range of estimates for Options 1 and 2 are $7.8M-$16.8M and $1.8M-$3.8M, respectively. Adding a fire suppression system to each building could be as much as three times the cost depending on the choice of suppression technology. Both of these designs adequately mitigate the consequences of the bounding accident occurring inside the confinement areas. Option 3, which is to perform open container operations within a temporary radiological containment system, e.g., a ventilated plastic hut that meets WSRC 5Q requirements, is recommended by the Facility Evaluation Team. The FET believes the low operational risk normally involved with open container processing does not justify the expense of either Options 1 or 2 and the low risk is appropriately managed by Option 3.

8.0 References

1. SWMF DSA, WSRC-SA-22, Revision 6
2. SWMF DSA, WSRC-SA-22, Revision Upgrade A (WSRC Approved)
3. WSRC E7 Procedure 2.25
4. DOE-HDBK-1169-2003, Nuclear Air Cleaning Handbook
5. Ventilation System Evaluation Guidance for Safety Related and Non-Safety –Related Systems, Revision 0
6. DOE-STD-3009-94
7. Estimate Summary Report, 07-06-02h, Rev. 0, issued 6/21/07, HWMW Storage Buildings 645-N, 645-2N, 645-4N
8. Estimate Summary Level Report, Project S-W547, issued 5/24/01, Mixed Waste Processing Facility

9.0 Attachments

Attachment 1 – Table 4.3, Confinement Documented Safety Analysis Information
Attachment 2 – Table 5.1, SWMF HWMW Storage Buildings
Attachment 3 – Option 1 Summary Description
Attachment 4 – Option 2 Conceptual Design Package System and Drawings
Attachment 5 – Facility Evaluation Team Biographical Sketches
Attachment 6 – N Area HWMW Facilities Aerial Photograph

ATTACHMENT 1
TABLE 4.3, CONFINEMENT DOCUMENTED SAFETY ANALYSIS INFORMATION

Confinement Documented Safety Analysis Information DNFSB 2004-2 Implementation Plan Table 4.3											
N-Area Facilities			Hazard Category 3				Performance Expectations				
Bounding Accidents	Type Confinement		Doses Bounding Unmitigated/ Mitigated	Confinement Classification			Function	Functional Requirements	Performance Criteria	Compensatory Measures	
	Active	Passive		SC	SS	DID					
Cat. 3 Facility Fire (Bulk Liquid Organic Waste)	There are no active confinement ventilation systems.	There are no passive confinement ventilation systems.	Unmitigated Offsite: 1.40E-01 rem Onsite: 2.69E+02 rem	NA	NA	NA	There are no credited DSA ventilation functions required.	There are no DSA ventilation functional requirements.	There are no required DSA ventilation performance criteria.	There are no DSA required compensatory measures for the ventilation system.	
643-29E Facility			Hazard Category 2				Performance Expectations				
Bounding Accidents	Type Confinement		Doses Bounding Unmitigated/ Mitigated	Confinement Classification			Function	Functional Requirements	Performance Criteria	Compensatory Measures	
	Active	Passive		SC	SS	DID					
High Inventory Container Fire	There are no active confinement ventilation systems.	There are no passive confinement ventilation systems.	Unmitigated Offsite: 1.10E-01 rem Onsite: 1.05E+02 rem	NA	NA	NA	There are no credited DSA ventilation functions required.	There are no DSA ventilation functional requirements.	There are no required DSA ventilation performance criteria.	There are no DSA required compensatory measures for the ventilation system.	
High Inventory Container Explosion	There are no active confinement ventilation systems.	There are no passive confinement ventilation systems.	Unmitigated Offsite: 3.66E-01 rem Onsite: 7.03E+02 rem	NA	NA	NA	There are no credited DSA ventilation functions required.	There are no DSA ventilation functional requirements.	There are no required DSA ventilation performance criteria.	There are no DSA required compensatory measures for the ventilation system.	
High Inventory Container Loss of Confinement (Spill)	There are no active confinement ventilation systems.	There are no passive confinement ventilation systems.	Unmitigated Offsite: 5.00E-01 rem Onsite: 9.0E+01 rem	NA	NA	NA	There are no credited DSA ventilation functions required.	There are no DSA ventilation functional requirements.	There are no required DSA ventilation performance criteria.	There are no DSA required compensatory measures for the ventilation system.	

(1) In accordance with the DOE 2004-2 Evaluation Guidance, storage of approved, closed waste containers is excluded from this evaluation

Attachment 2 – Table 5.1 – SWMF Hazardous and Mixed Waste Storage Buildings

	TABLE 5.1 - SWMF HAZARDOUS AND MIXED WASTE STORAGE BUILDINGS	
EVALUATION CRITERIA	DISCUSSION	REFERENCES
	Ventilation System - General Criteria	
Pressure differential should be maintained between zones and atmosphere	Currently there are no active confinement ventilation systems in these buildings.	DOE-HDKB-1169 (2.2.9) ASHRAE Design Guide
Materials of construction should be appropriate for normal, abnormal and accident conditions	Currently there are no active confinement ventilation systems in these buildings. .	DOE-HDKB-1169 (2.2.5) ASME AG-1
Exhaust system should withstand anticipated normal, abnormal and accident system conditions and maintain confinement integrity	Currently there are no active confinement ventilation systems in these buildings.	DOE-HDKB-1169 (2.4) ASHRAE Design Guide
Confinement ventilation systems shall have appropriate filtration to minimize release	Currently there are no active confinement ventilation systems in these buildings.	ASME AG-1 DOE-HDBK-1169 (2.2.1)
	Ventilation System - Instrumentation and Control	
Provide system status instrumentation and/or alarms	Currently there are no active confinement ventilation systems in these buildings.	ASME AG-1 DOE-HDBK-1169 ASHRAE Design Guide (Section 4)
Interlock supply and exhaust fans to prevent positive pressure differential	Currently there are no active confinement ventilation systems in these buildings.	DOE-HDBK-1169 ASHRAE Design Guide (Section 4)
Reliability of control system to maintain confinement function under normal, abnormal and accident conditions	Currently there are no active confinement ventilation systems in these buildings.	DOE-HDBK-1169 (2.4)

Control components should fail safe	Currently there are no active confinement ventilation systems in these buildings.	DOE-HDBK-1169 (2.4)
Resistance to Internal Events - Fire		
Confinement ventilation systems should not propagate spread of fire	Currently there are no active confinement ventilation systems in these buildings.	DOE-HDBK-1169 (10.1) DOE-STD-1066
Testability		
Design supports the periodic inspection and testing of filters and housing, and tests and inspections are conducted periodically	Currently there are no active confinement ventilation systems in these buildings.	DOE-HDBK-1169 (2.3.8) ASME AG-1 ASME N510
Instrumentation required to support system operability is calibrated	Currently there are no active confinement ventilation systems in these buildings.	DOE-HDBK-1169 (2.3.8)
Maintenance		
Filter service life program should be established	Currently there are no active confinement ventilation systems in these buildings.	DOE-HDBK-1169 (3.1 & App C)

Attachment 3 – Option 1 Summary Description
Ventilation System Design for Building 645-N, 645-2N and 645-4N

System Design Description: The ventilation system per this conceptual design will operate continuously on 24/7 365 basis to maintain the building at a negative pressure. The systems will prevent spread of contamination by ventilating each building at the rate of 8 Air Change per Hour (ACH).

Mechanical and Instrumentation Scope for Buildings 645-N, 645-2N and 645-4N

The building negative pressure will induce outdoor air into the building thru the engineered openings located at east and west walls. This air will be exhausted by a fan thru the grilles and duct to stack via High Efficiency Particulate Absolute (HEPA) filters of 99.99% efficiency to remove airborne contamination. Duct and filter housing will be fabricated from stainless steel.

For a reliable system operation instruments will indicate differential pressure between the building and atmosphere, prefilter, HEPA filter and system airflow. In addition an alarm signal will be sent to an annunciator panel in building 645-2N administration office for loss of building differential pressure, high PD across prefilter, and HEPA filter and low system airflow conditions. The HEPA filters for theses system will be procured per SRS filter program. The filter housing will be designed to allow in-place testing.

Civil, Structural and Architectural Scope for Buildings 645-N, 645-2N and 645-4N

The Civil, Structural, and Architectural scope of this conceptual design includes work to support the ventilation system installation. Building and site modifications will be required as delineated by the following detail scope by building number

645-2N
The roof of the building will need modification to close the roof ridge and roof fans with specific locations and details provided for flashing installations. A new fan slab, stack foundation and duct supports will be required to complete installation of the HEPA filter, fan and stack assembly. Design calculations will be required for the stack, slab and support designs. Civil sitework will be required to provide drainage around the new slab and stack system, including erosion control.

645-4N
The roof of the building will need modification to close the roof ridge and 2 wall bays with specific locations and details provided for flashing installations. A single 3 ft. gate and one (1) 20 ft. wide roll-up door is required to complete the building closure. A new fan slab, stack foundation and duct supports will be required to complete installation of the HEPA filter, fan and stack assembly. Design calculations will be required for the stack, slab and support designs. Civil sitework will be required to provide drainage around the new slab and stack system.

645-N

The roof of the building will need modification to close the roof ridge and two long walls of the building with specific locations and details provided for flashing installations. Two (2) 3 ft. gates and seven (7) 10 ft. wide roll-up doors are required to complete the building closure. A new fan slab, stack foundation and duct supports will be required to complete installation of the HEPA filter, fan and stack assembly. Design calculations will be required for the stack, slab and support designs. Civil sitework will be required to provide drainage around the new slab and stack system.

Note that an Erosion Control Plan for all three (3) buildings will need to be prepared, as well as construction permit support, and Site Clearance permits.

<u>Electrical Scope for Buildings 645-N, 645-2N and 645-4N</u>

The electrical scope will provide design to tap into the closest 13.8 KV feeder. The electrical load will require installation of a 200A fused cutout to support the new fans and other electrical components. This will require installation of three (3) conductor #2 15KV with ground shielded cable from the disconnect switch to a new 150 KVA transformer in the area. Drawing changes will include revisions to the Single Line drawing for the area. Completing the power supply will include installation of a NEMA 3R Power Distribution Junction Box on the secondary side of the transformer, and the installation of two (2) – 100A and one (1) – 200A Disconnect Switch on the secondary side of the transformer within 10 feet.

To provide power to buildings 645-N and 645-4N, installation of three (3) conductor #2 tray cable with ground in existing trays and new 1 ½" conduit from the 100A disconnect switch to each fan system and HEPA filter units. Connect respective wiring to the combination starters supplied with the fan system.

To provide power to building 645-2N, installation of three (3) conductor #2/0 tray cable with ground in existing trays and new 1 ½" conduit from the 200A disconnect switch to the fan system and HEPA filter unit in 645-2N. Connect wiring to the combination starters supplied with the fan system.

For each of the buildings, 645-N, 645-2N and 645-4N, install three (3) conductor #12 tray cable in ¾" RMC between the differential pressure gauges and the pressure switches in the HEPA filter assembly. Also required for the alarm system installation, install three (3) conductor #12 tray cable in existing trays and new ¾" conduit from the pressure switches to the administration building 645-1N. To complete the system, install three (3) alarm units in administration building 645-1N.

The scope is based upon the assumption that 13.8 KV will be available close to the buildings and the 150 KVA transformer will be installed next to the existing 225 KVA transformer.

These design features will ensure the system and facility function within the requirements of DNFSB 2004-2 by meeting the applicable requirements of DOE HDBK 1169-03, ASHRAE, and ASME AG-1 codes and standards.

7.0 ENVIRONMENTAL CONTROL

7.1 Ventilation System

The H&V system shall be designed to meet the requirements of ERDA 76-21 and the American Society of Heating, Refrigeration and Air-conditioning Engineers, Inc. (ASHRAE) Design Guide for Department of Energy Nuclear Facilities.

The designations of the building zones shall be Secondary confinement and Primary Confinement.

Ventilation for the MWPU shall include two systems. The first system is the conditioned Make-up Air System, which serves the Secondary and Primary areas of the facility. The second system is the exhaust air system, which includes the secondary and primary areas, and the air exhausted from secondary and primary areas shall pass through HEPA filtration.

The ventilation system serving the structure shall contain enough HEPA filters to handle the volume of air as required and provide minimum filter efficiency (i.e., 99.97% of 0.3 micron and larger particles).

After passage through the independent paths of filtration, the exhaust shall be discharged to the atmosphere via a stack.

A filter efficiency of 99.97% as determined by Aersol Challenge Agent testing shall be required for all HEPA filters. All filters shall be accessible for periodic Aersol Challenge Agent testing. In addition, HEPA filter housings or ducts shall contain appropriate fittings to allow Aersol Challenge Agent testing.

Design shall provide enough HEPA filter capacity to always have a spare bank available to be placed on-line when changing out HEPA filters.

Instrumentation on HEPA filters shall be provided.

Local exhausters shall be provided around the sort table, the drum vent system, carboy loading station, and drum pump transfer station.

Air locks shall be provided between the secondary and primary areas. Air lock design shall prevent backflow of contamination from areas of higher contamination potential to areas of lower potential by maintaining at a greater negative pressure than the lesser contamination potential areas.

The MWPU will be provided with make-up air that is heated/conditioned and includes humidity control. Two 50% make-up air units will be provided.

Interlocks to stop supply fans make-up if two exhaust fans stop shall be provided to keep from over pressurizing radiological controlled areas and having an air flow reversal.

The HVAC system design shall be considered to accommodate loads of at least 15% greater than the nominal expected loads, through either the initial capacity or provisions for increasing the installed capacity.

The heating and cooling capacity for the air conditioning and heating equipment shall be sized using weather data obtained from local or site weather stations.

Outside air for personal ventilation air requirements shall meet the requirements of ASHRAE HVAC design guide for DOE Nuclear Facilities.

HVAC systems shall satisfy the noise control (NC) levels recommended for various types of spaces and vibration criteria as listed in the ASHRAE handbooks.

All HVAC equipment and systems shall be fabricated, installed, tested, adjusted and balanced in accordance with guidelines in ASHRAE system handbook, AABC Volume A-82, and as required by SRS Engineering Standards.

Air handling units shall comply with ASHRAE standard 90.1, NFPA 90A, AMCA Publication 99, 261 and ARI 430. All fans shall comply with AMCA standard 210 and ASHRAE standard 51. All fans and accessories shall be designed and specified to meet all smoke and flame spread requirements of NFPA 255.

Heating and cooling coils shall comply with ARI 410.

Air-cooled condensers and condensing units shall meet the standards, rating, and testing requirements of ARI 460, and ASHRAE standard 20.

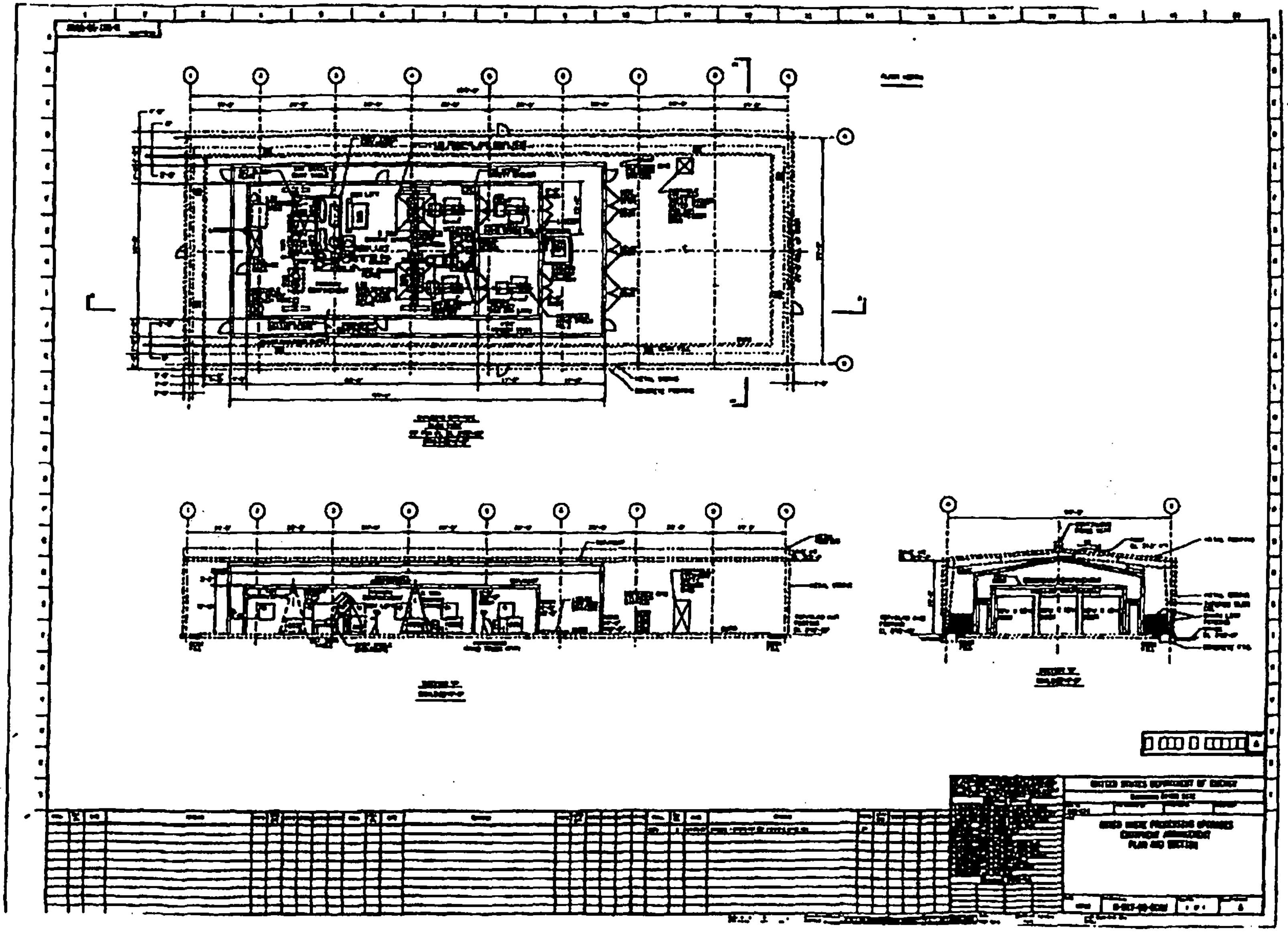
7.2 Ventilation Control

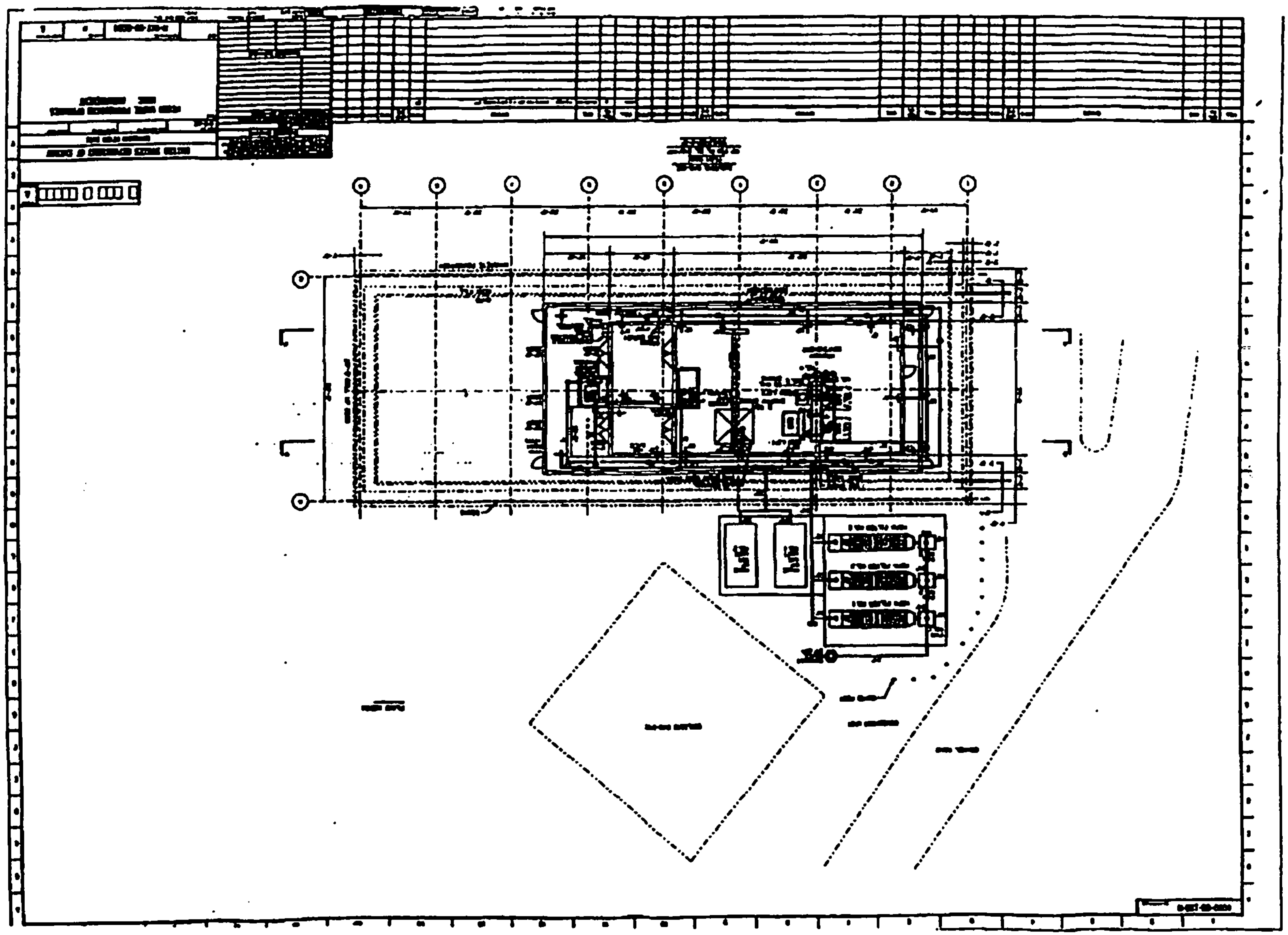
Building pressure differentials shall provide ventilation flow from clean areas and areas of lesser contamination to Radiologically Buffer Areas (RBA) of greater contamination, to HEPA filter systems, and to the exhaust stack. The entire structure shall be kept negative with respect to atmospheric pressure.

Radiologically controlled areas shall be designed to meet ASHRAE requirements for air changes/hour. Secondary confinement shall be four to six air changes/hour and the primary confinement shall be six to ten air changes/hour.

A sequence of operation describing all HVAC controls systems, including interlocks and set points, shall be provided by the design agency during final design.

All branch ducts shall contain a manual volume damper.


UNITED STATES DEPARTMENT OF ENERGY
PLAN AND SECTION



Attachment 5
Facility Evaluation Team Composition and Biographical Sketches

R. T. Duke - Technical Advisor, Waste Management Area Project

Roger Duke has a Bachelor of Mechanical Engineering from Auburn University and a Masters of Mechanical Engineering from University of South Carolina. He has 30 years of experience at the Savannah River Site in Aiken, South Carolina. He has held numerous positions in areas of Project Management and Program Management. Roger has been the Program Manager for Environmental Protection, Soil and Groundwater, Solid Waste and Decontamination and Decommissioning programs. His current position is Technical Advisor for the Waste Management Area Project Engineering Department.

Tam Tran – Lead, DOE Authorization Basis for Solid Waste Facilities

Tam Tran has Masters of Science in nuclear engineering and environmental engineering . He has over 20 years of experience with Texas A&M University Research Station, Tennessee Valley Authority, and Savannah River Site. He has held numerous positions in areas of nuclear safety licensing, performance assurance, and nuclear material management . He is currently the DOE Authorization Basis Engineer lead for Solid Waste facilities and operation.

S. E. Crook – Manager, WMAP Safety Compliance

Steve Crook has a Bachelor of Science degree in Chemical Engineering from Purdue University. He has 21 years of experience at the Savannah River Site, holding a variety of positions in the waste management area including project engineering, environmental compliance engineering and management, and nuclear safety compliance engineering and management. For the last seven years Steve has been the manager of the Safety Compliance group in Waste Management Area Project engineering. Prior to the Savannah River Site, Steve held several positions in the petrochemical process industry with Monsanto and later duPont as a project engineer and later a process/production engineer in ethylene and coproducts manufacturing.

P. N. Fairchild – TRU Engineering Lead, Waste Management Area Project

Mr. Peter Fairchild received a Bachelor of Science degree in Mechanical Engineering from the University of South Carolina in 1988. He has been at the Savannah River Site since 1988 and joined the Waste management Area Project (WMAP) Team in October of 2005. Peter is currently the TRU Engineering Lead for the Waste Management Area Project. Before being assigned to WMAP, he served on the Facility Evaluation Board and a Design Authority Engineer and Maintenance Engineer for Spent Fuel Programs. He has had various other assignments at Savannah River including Separations Works ~~Engineering, where he assisted with the acceptance testing for the H Canyon Warm~~ Crane. Peter also served as Design Authority for Compressed Air and Emergency

Electrical Power Systems for Reactor Restart Division and in Spent Fuel Programs. Peter has been active with several technical committees. He has served as Chairman of the Site Predictive Maintenance Council, Chairman of the Site Lubrication and Filtration Council, Spent Fuel Programs Conduct of Engineering Committee Representative and has supported the Engineering Standards Board on issues related to compressed air, lubrication and diesel fuel quality. He also co-authored the Diesel Fuel Quality chapter of the DOE Backup Power Working Group Handbook and served as a core member of the Electrical Power Research Institute, (EPRI) Diesel Fuel Owners Group.

Attachment 6 – N Area HWMW Facilities Aerial Photograph

SEPARATION

PAGE

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DOE F 1325.8

United States Government

Department of Energy

memorandum

Carlsbad Field Office
Carlsbad, New Mexico 88221

DATE: NOV 01 2007

REPLY TO ATTN OF: CBFO:OSO:RF:KJB:07-0565:UFC4700

SUBJECT: Evaluation of WIPP Ventilation Systems in Response to Defense Nuclear Facilities Safety Board Recommendation 2004-2, Final Reports

TO: James M. Owendoff, Chief Operations Officer for Environmental Management

In response to a memorandum for distribution dated March 30, 2007, from Inés Triay to DOE Field Managers, the Carlsbad Field Office (CBFO) has prepared final reports in accordance with *DNFSB 2004-2 Ventilation System Evaluation Guidance* (VSEG) to support the Office of Environmental Management's (EM) response to Recommendation 2004-2. The attachments are final reports that include the requested information for the Waste Isolation Pilot Plant (WIPP) ventilation systems. The specific systems are listed below:

- Surface Waste Handling Building (WHB) Confinement Ventilation System (CVS) Supporting Contact-Handled (CH) Waste Disposal Operations – System Designation CH CVS 411 HV01,
- Surface WHB CVS Supporting Remote-Handled (RH) Waste Disposal Operations – System Designation RH CVS 411 HV02,
- Underground Ventilation CVS Supporting CH Waste Disposal Operations – System Designation CH UG CVS VU01
- Underground Ventilation CVS Supporting RH Waste Disposal Operations – System Designation RH UG CVS VU01.

WIPP Site evaluation teams utilized the VSEG Independent Review Panel (IRP) functional classification criteria for system evaluations. Also, evaluations were performed utilizing the WIPP CH waste disposal operations documented safety analysis (DSA), *DOE/WIPP-95-2065, Revision 10, November 2006*, and the RH waste disposal operations DSA, *DOE/WIPP-06-3174, Revision 0, March 2006*.

The tables included in each attached final report identify how the VSEG evaluation criteria are met for the four listed WIPP Site CVSs. The system evaluations contained in the reports do not identify any "gaps" between the installed systems' functional design and performance expectations.

If you have any questions or comments regarding this material, please contact me at (505) 234-7300 or Mr. Vernon Daub at (505) 234-7208.

David C. Moody
David C. Moody
Manager

Attachments

cc w/attachments:

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*ED denotes Electronic Distribution

CBFO:OSO:RF:KJB:07-0565:UFC4700

DOE Waste Isolation Pilot Plant

Contact Handled Surface Confinement Ventilation System 411 HV01

Ventilation System Evaluation

Revision 0, October 25, 2007

Review and Approval Page

Site Lead:

Richard Farrell	Signature on File	Date: ______

Evaluation Team Members:

Curtis A. Chester	Signature on File	Date: ______
Randy D. Elmore	Signature on File	Date: ______
John J. Garcia	Signature on File	Date: ______

DOE Field Office Manager:

Dave Moody	Signature on File	Date: ______

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Definitions

Safety Class.

Safety Class (SC) systems structures and components (SSCs) are those whose preventive or mitigative function is necessary to keep radiological material exposure to the public below the off-site evaluation guideline, which is 25 rem (roentgen equivalent man) total effective dose equivalent. The dose estimates to be compared to it are those received by a hypothetical maximally exposed off-site individual at the site boundary.

Safety Significant.

SSCs not designated as SC, but whose preventive or mitigative function is a major contributor to defense in depth (DiD) and/or worker safety as determined from hazards analysis. Safety Significant (SS) SSC designations based on worker safety are limited to those whose failure is estimated to result in a prompt worker fatality or serious injuries or significant radiological or chemical exposure to workers.

Waste Isolation Pilot Plant (WIPP) procedure WP 09-CN3023, *WIPP Functional Classification for Design*, Rev. 7 identifies greater than 100 rem to the worker as the consequence for requiring consideration for functionally classifying an SSC as SS.

Abbreviations and Acronyms

CH – Contact Handled

Ci – Curie

CMR – Central Monitoring Room

CMS – Central Monitoring System

CVS – Confinement Ventilation System

DBE – Design Basis Earth Quake

DBT – Design Basis Tornado

DiD – Defense in Depth

DSA – Documented Safety Analysis

EG – Evaluation Guideline (25 rem TEDE to the maximally-exposed offsite individual as defined in DOE-STD-3009-94)

FET – Facility Evaluation Team as defined in the VSEG

HEPA – High Efficiency Particulate Air

IRP – Independent Review Panel as defined in the VSEG

PDD – Pressure Differential Damper

PE-Ci – Plutonium Equivalent Curies

PISA – Potentially Inadequate Safety Analysis

Pu-239 – Plutonium 239

rem – roentgen equivalent man

RH – Remote Handled

SC – Safety Class

SS – Safety Significant

SSCs – Systems, Structures and Components

SWB – Standard Waste Box

TEDE – Total Effective Dose Equivalent

TDOP – Ten Drum Over Pack

VSEG – Department of Energy, Deliverables 8.5.4 and 8.7 of Implementation Plan for Defense Nuclear Facilities Safety Board Recommendation 2004-2, *Ventilation System Evaluation Guidance for Safety-Related and Non-Safety-Related Systems*

WIPP – Waste Isolation Pilot Plant

Executive Summary:

The Waste Isolation Pilot Plant (WIPP) site is a low level repository for radioactive waste. Waste is characterized and shipped to WIPP in packages for disposal in the repository. The container that the waste is packaged in prior to loading into transportation containers (road casks) provides primary containment. There is no planned normal operation at WIPP that allow for waste to be present external to the waste package container primary containment. The waste container packages that are used for disposal are removed from the transportation containers (road casks) in the Waste Handling Building (WHB). From the time the packages are removed until they are placed in the repository, the packages are contained within facilities and structures with active confinement ventilation systems.

Contact Handled (CH) surface waste handling operations are performed in the CH portion of the WHB. The CH Confinement Ventilation System (CVS) 411 HV01 provides the active CVS for the CH surface waste handling operations. This system is not credited in the site Documented Safety Analysis (DSA) analyzed accident scenarios to control hazardous release. The evaluated CVS performs a Defense in Depth (DiD) function for the WIPP site. WIPP is a Hazard Category 2 facility. The facility evaluation team (FET) used the independent review panel (IRP) directed functional classification criteria for Safety Significant (SS). Based on the evaluation criteria, the system evaluation did not reveal any "gaps" in the installed system's functional design or performance expectations. The installed system's functional design and performance expectations is commensurate with the identified site mission of receiving prepackaged and characterized waste and emplacing the waste in the waste container packages in which the waste is received on site. During the evaluation of the systems functional design and performance expectations against the evaluation criteria and the facility DSA, there was no discovery of a potentially inadequate safety analysis (PISA).

Introduction

Facility Overview

The WIPP is located in Eddy County in southeastern New Mexico. The WIPP is located in an area of low population density with no industrial, commercial, institutional, recreational or residential structures within the WIPP Site Boundary.

The WIPP is designed to receive and handle 500,000 cubic feet per year (ft^3/yr) (14,160 cubic meters per year [m^3/yr]) CH waste and 10,000 ft3/yr (283 m^3/yr) RH waste. The WIPP facility is designed to have a disposal capacity for TRU waste of 6.2 million ft^3 (175,600 m^3). The WIPP facility has sufficient capacity to handle the 250,000 ft^3 (7,080 m^3) of RH waste. The WIPP is divided into surface structures, shafts, and subsurface structures

.

The WIPP surface structures accommodate the personnel, equipment, and support services required for the receipt, preparation, and transfer of waste from the surface to the underground. The primary surface operations at the WIPP are conducted in the WHB, which is divided into the CH waste handling area, the RH waste handling area, and support areas. The CH waste handling area includes the entrance airlocks, CH bay, a shielded storage room, and CH support facilities. Vertical shafts, including the waste shaft, the salt handling shaft, the exhaust shaft, and the air intake shaft, extend from the surface to the underground horizon. The waste shaft is located between the CH and RH areas in the WHB.

The WIPP underground consists of the waste disposal area, construction area, north area, and the waste shaft station area. The CH and RH waste disposal area is a 100 acre area on a horizon located 2,150 feet beneath the surface in a deep, bedded salt formation.

CH waste is disposed of in the rooms and panel entries of each room. CH waste arrives to the WIPP in drum assemblies, SWBs, or TDOPs. Drum assemblies and SWBs are stacked three high, and may be intermixed within rows and columns. TDOPs are placed on the bottom row. Four-packs of 85-gallon drums and three-packs of 100-gallon drums are placed on top of assemblies of the same type or placed on the top row for stability.

The hazard classification category was determined in accordance with DOE-STD-1027-92. The material at risk for the determination of the categorization was defined as the maximum radiological contents of a single 55-gallon drum of CH waste at 80 plutonium-239 equivalent curies (PE-Ci). Since this inventory exceeds the Hazard Category 2 minimum threshold of 56 Ci for Pu-239, the WIPP is categorized as a Hazard Category 2 facility.

Confinement Ventilation Strategy

The WIPP CVS are designed to provide confinement barriers utilizing high efficiency particulate air (HEPA) filtration to limit releases of airborne radioactive contaminants. Exhaust stacks are designed with elevated discharges and fresh air supply intakes located away from the exhaust vents. The ventilation systems provide pressure differentials that are maintained between building interior zones and the outside environment. The WHB ventilation systems continuously filter the exhaust air from waste handling areas to reduce the potential for release of radioactive effluents to the environment. Airlocks for ventilation differential pressure control are electrically interlocked and are provided in the following locations:

- At entrances to potentially contaminated areas to maintain a static barrier
- Between areas of large pressure differences to provide a pressure transition and to eliminate high air velocity
- Between areas where pressure differentials must be maintained
- To minimize air movement from the WHB to the waste shaft

The ventilation systems include monitoring of the following operating parameters:

- Pressure drop across each pre-filter and HEPA filter bank
- Air flow rates at selected points
- Pressure differentials surrounding areas of high potential for contamination levels

Each supply air handling unit consists of filters, cooling coils, heating elements, fans with associated duct work, and controls to condition the supply air maintaining the design temperature during winter and summer. Fan operating status, filter bank pressure drops, and static pressure differentials can be monitored locally or in the CMR. Conditions that alarm in the CMR are excess filter pressure drop and loss of air flow. Instruments and system components are accessible for, and will be subject to, periodic testing and inspection during normal plant operation.

The WHB supply and exhaust fans are designed and interlocked to maintain building pressure negative with respect to atmospheric pressure and maintain the design air flow pattern. During normal operation, if the operating exhaust/supply fan fail, the corresponding supply/exhaust fan is stopped. The standby train is started automatically and can also be started manually.

The Station C effluent sampling system continuously samples the air discharged from the WHB exhaust vent downstream of HEPA filtration. Tornado dampers, constructed to withstand the design basis earthquake (DBE) and Design basis tornado (DBT), are installed in all heating ventilation and air conditioning inlet and exhaust openings in the WHB. In the event of a tornado, the WHB tornado dampers will automatically close to prevent the outward rush of air caused by a rapid drop in atmospheric pressure. Damper closure mitigates damage to HEPA filters from a potential high differential pressure.

The WHB exhaust fans and controls can be supplied by backup power in the event that normal power is interrupted. In case of an off-site power failure, the capability exists to selectively switch one exhaust fan to the backup power system.

The filtration system consists of prefilters and HEPA filters sized in accordance with design air flows utilizing industry standards for maximum efficiency. All nuclear grade HEPA filter banks are tested for conformance with ASME N510 (SDD HV00, Heating, Ventilation and Air Conditioning System).

The CH surface CVS equipment was installed in the WHB facility in the mid 1980's. Between 1998 and 2000, the pneumatic control system was replaced with a microprocessor based distributive control system. Constant volume terminal units were installed in the supply system to enhance the stability of the space pressure. The original design information is still maintained and available via site records.

Currently an air recirculation modification is in progress. This is not considered a major modification. Duct and dampers have been installed to allow air within specific zones to be recirculated. The related control system is not yet functional and is awaiting a window of opportunity for deployment. The recirculation modification is being installed in accordance with DOE-HDBK-1169-2003 guidance and recommendations. The recirculation modification has been evaluated and will not negatively impact system confinement capabilities or ALARA practices.

Major Modifications

The facility is not currently undergoing any major modifications that affect the ventilation system or its operation. There are future plans under consideration to make facility modifications to allow the shipment of larger volume rectangular waste containers. This facility modification will have very limited impact to the installed configuration of the CH surface CVS and even less impact on the features and operation of the CVS.

Functional Classification Assessment

The WIPP procedure WP 09-CN3023, WIPP Functional Classification for Design, is the site procedure used for functional classification.

Existing Classification

Based on site procedures the CH surface CVS of this evaluation is classified as a balance of plant system providing a DiD function. This CVS is not credited in the site DSA for providing a safety class or safety significant function.

Evaluation

The FET used the proceduralized site process, WP 09-CN3023, to evaluate the existing site functional classification of the CVS evaluated. Additionally, the FET reviewed the site procedure for compliance with DOE regulations and drivers to assess that the site procedure provides adequate assessment of functional classification for site systems.

The CH surface CVS was found to have the proper existing functional classification per WP 09-CN3023.

The procedure, WP 09-CN3023, was found to be inline with the DOE-STD-3009-94 guidance for functional classification. The FET did discover one typographical error in the procedure. The error is being corrected.

Summary

The existing facility functional classification is commensurate with the identified site mission of receiving prepackaged and characterized waste and emplacing the waste in the packages in which it was received, in the site repository.

System Evaluation

Identification of Gaps

The FET identified there were no gaps between the *Ventilation System Evaluation Guidance for Safety-Related and Non-Safety-Related Systems* (VSEG) evaluation criteria and the installed system's functional design or performance expectations.

The FET used the IRP directed SS performance criteria for the evaluation in accordance with the guidance in section 5.1 of the VSEG. Section 5.1 identifies that all hazard category 2 nuclear facilities that do not challenge or exceed the evaluation guideline (EG) will utilize SS performance criteria as identified in Table 5-1 of the VSEG.

The evaluation verified all the VSEG established performance criteria for SS CVS systems were adequately met by the CVS. The criteria established to be mandatory for this evaluation were:

a. Materials of Construction should be appropriate for normal, abnormal and accident conditions.

b. Confinement ventilation systems shall have appropriate filtration to minimize release.
c. Provide system status instrumentation and/or alarms.
d. Interlock supply and exhaust fans to prevent positive pressure differential.
e. Post accident indication of filter break-through.
f. Reliability of control system to maintain confinement function under normal, abnormal and accident conditions.
g. Control components should fail safe.
h. Administrative controls should be in place to protect confinement ventilation systems from barrier threatening events.
i. Design supports periodic inspection and testing of filters and housing, and tests and inspections are conducted periodically.
j. Filter service life program should be established.
k. Failure of one component (equipment or control) shall not affect continuous operation.
l. Backup electrical power shall be provided to all critical instruments and equipment to operate and monitor the CVS.

The above listed criteria are required for the system to adequately provide mitigative DiD performance.

All other IRP established VSEG performance criteria, identified in Table 5-1 of the VSEG, were non-mandatory. The non-mandatory criteria were identified within the VSEG to be "applicable as required" or "credited by the facility DSA". The facility DSA does not credit the CH surface CVS to prevent or control hazardous release in the accident analyses.

Gap Evaluation

The FET identified there were no gaps between the VSEG evaluation criteria and the installed system's functional design or performance expectations, whether mandatory or non-mandatory.

Modifications and Upgrades

There are no required modifications or upgrade to the CH surface CVS since there are no gaps between the established performance criteria and the install as system's functional design or performance expectations.

Conclusion

The FET performed an evaluation of the CH surface CVS. The result of the evaluation was a determination that the system's installed design and performance expectations met the evaluation performance criteria established by the VSEG IRP for a Hazard Category 2 facility. There were no significant findings or proposed corrective actions as a result of this evaluation.

The FET did identify the opportunity to improve pressure differential damper (PDD) control characteristics and component reliability by the installation of additional controllers at specific PDDs. The identified item is not a mandated change and is recognized as opportunity for enhancement to be scheduled and processed based on site priorities.

References

ASME N510 — American Society of Mechanical Engineers, 1989, *Standard for Testing of Nuclear Air Cleaning Systems*, (formerly ANSI N510-1975, ANSI/ASME N510-1989)

CH DSA — DOE/WIPP-95-2065, REVISION 10, NOVEMBER 2006, Waste Isolation Pilot Plant Contact Handled (CH) Waste Documented Safety Analysis, with approved page changes CH-2007-01 and CH-2007-02, August 27, 2007

DOE-STD-3009-94 — DOE Standard Preparation Guide for U.S Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses, with Change Notice No. 2, April 2002

DOE-STD-1027-92 — DOE Standard, Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports, with Change Notice No. 1, September 1997

DOE HDBK-1169-2003 — DOE Handbook, Nuclear Air Cleaning Handbook

RH DSA — DOE/WIPP-06-3174, REVISION 0, MARCH 2006, Waste Isolation Pilot Plant Remote Handled (RH) Waste Documented Safety Analysis, with page changes approved through August 28, 2007

SDD HV00 — U.S. Department of Energy, Waste Isolation Pilot Plant, Heating, Ventilation and Air Conditioning System, System Design Description (SDD), Rev. 10

WP 09-CN3023 — *WIPP Functional Classification for Design*, Rev. 7

Attachments

Facility Evaluation Team composition and biographical sketches

Attachment 1 – FET members' Personnel Profiles

Data Collection Table and supporting attachments

Attachment 2 – Data Collection Table

Table 4-3

Attachment 3 - Supporting Attachments

CH Surface CVS 411 HV01, Table 5-1 Ventilation System Performance Criteria and Evaluation Response

Summary Schedules for implementing upgrades

Not applicable – no identified "gaps" or required upgrades

Completed supporting evaluations and documentation

Not applicable.

Attachment 1

Field Evaluation Team Personal Profiles

Attachment 1

Personal Profile: **Richard F. Farrell**
Position: **Nuclear Safety Specialist**
U. S. DOE Carlsbad Field Office
(505) 234-8318

Summary:

1. Environmental, Safety, and Health (E,S&H) professional with over 30 years of diversified experience in nuclear and industrial safety, health physics, environmental/effluent monitoring, regulatory compliance related to state-of-the-art nuclear facilities, and mining and mineral extraction/ metallurgical processing.
2. Managed the development of the Waste Isolation Pilot Plant (WIPP) documented safety analysis (DSA) for contact-handled and remote-handled transuranic (CH/RH-TRU) waste disposal operations. Developed and the Department of Energy's (DOE) safety evaluation reports (SER) or approval bases associated with the WIPP safety basis.
3. Developed and managed the Radioactive Source Materials License compliance programs for a NRC licensed facility (an operating uranium mill/mine) including: radiological and industrial safety, ALARA, quality assurance, occupational health, and underground mine ventilation engineering and monitoring.

Experience:

U. S. Department of Energy; September 2007 - Present
Nuclear Safety Specialist Carlsbad Field Office (CBFO) Responsibilities include oversight and integration of CBFO/WIPP radiological and nuclear safety, occupational health, and nuclear safety management.
Safety Officer CBFO; August 2000 – September 2007 Responsibilities include oversight and integration of CBFO/WIPP industrial, radiological and nuclear safety, and occupational health.

U. S. Department of Energy; September 1992 - August 2000
Radiological Safety Manager Carlsbad Area Office (CAO) Responsibilities include oversight and management of CAO/WIPP radiological safety/control programs (10 CFR Part 835) and nuclear safety management (10 CFR Part 830).

Westinghouse Electric Corporation; April 1990 - September 1992
Senior Engineer at the Waste Isolation Pilot Plant Responsibilities include the management of interface activities with oversight and auditing groups, evaluation of applicable regulations and DOE orders, and support of audits of waste generator sites with regard to waste acceptance criteria.

Homestake Mining Company; 1977 - April 1990
(Nuclear Regulatory Licensed Uranium Milling and Mining)
Environmental Safety and Health Department On-Site Manage; 1983 - April 1990
Responsible for radiation safety/health programs as the radiation safety officer (RSO) for the Nuclear Regulatory Commission (NRC) licensed facility. Responsibilities included department administration, industrial safety/health, emergency management, RCRA compliance and hazardous waste management, CERCLA remediation and monitoring activities, occupational health and regulatory compliance.

Attachment 1

Radiation Protection Administrator; 1980 - 1983 Responsibilities included management of the health physics, oand hazardous waste activities, training, environmental and effluent monitoring, and regulatory compliance. Served as the RSO for a NRC licensed facility.
Radiological Safety/Environmental Engineer; 1977 - 1980 Responsibilities included evaluation of radiological safety, health physics assessment, monitoring data, and the development of monitoring and emission control programs to assure compliance with occupational and environmental regulations.

Education:

B.S. - Chemistry major - biology minor, Northern Arizona University, 1975.
Twelve (12) semester hours of graduate level chemistry class work, and six (6) semester hours of graduate level radioactive waste management; University of New Mexico; 1981 and 1992, respectively.
Strong background in applied mathematics and statistics equivalent to a minor area of study [twenty (20) semester hours], Brigham Young University; 1993 - 1996.

Attachment 1

Personal Profile: **Curtis A. Chester**
Position: **Engineering Manager**
Integrated Waste Handling Engineering
Washington TRU Solutions LLC
WIPP Site

Summary:

Mr. Chester is the Washington TRU Solutions manager of the Integrated Waste Handling Engineering (IWHE) group. IWHE is responsible for the technical ownership of all equipment used in the waste handling process, both Contact Handled and Remote Handled. Mr. Chester's staff consists of 17 engineers engaged in oversight of systems that include such diverse applications of engineering as robotics in waste processing, radiological monitoring systems, pumping and distributions systems for fire suppression, industrial material handling systems, facility structural integrity (including seismic and tornado loading) and confinement ventilation. The IWHE group is tasked with monitoring, maintaining, designing and planning the implementation of regulatory requirements associated with aspects of safety, environmental and radiological requirements for the site waste handling process. As manager of the IWHE group, Mr. Chester is responsible for administration of the proper oversight, review and approval of the actions implemented by the group.

Mr. Chester has participated in two successful Operational Readiness Reviews while at WIPP and was the lead engineer in the successful completion of the Remote Handled readiness review completed in January of 2007 including the system Start-up Testing and the system Line Management Assessment. Mr. Chester's experience and accomplishments in mechanical design, shop fabrication, procurement, engineering application of quality control and application of industrial process control make him uniquely suited for management of the IWHE group.

Professional History:

Manager / Integrated Waste Handling Engineering (1998 to present)
<u>WGI/ Washington TRU solutions</u> Carlsbad, New Mexico
Management of personnel employed in the development and implementation of strategies, resource allocations, baselines, and project execution plans for package handling equipment, system upgrades, and processes supporting the disposal of Defense Nuclear Waste. Successes and competence have been identified with a continuous progression of assignments from support engineer to engineering staff management.

Project Engineer / Staff Consultant (1993 to 1997)
<u>Duke Engineering & Services</u> Carlsbad, New Mexico
Provide design, analysis, and project management services to engineering and maintenance staff at the Waste Isolation Pilot Plant (WIPP).

Product Integrity Engineer/ Lead Manufacturing Engineer (1990 to 1993)
<u>Martin Marietta Corporation</u> Albuquerque, New Mexico
Develop and maintain process flow instructions and configuration management for multiple process lines. Conduct engineering analysis on mechanical structures and assemblies. Develop and implement quality, cost effective manufacturing practices regarding station layouts, sequence of operations, and tooling requirements.

Staff Engineer (1989-1990, 1993)

Attachment 1

Pharmacia SP Albuquerque, New Mexico
Perform engineering analysis on equipment. Develop equipment enhancements. Design and prototype special devices.

Education:

B.S. in Mechanical Engineering, **UNM Albuquerque, NM,** 1989

Publications:

"Final Results of the WIPP RH TRU Facility Shielding Analysis". 2002
"Exhaust Shaft Hydraulic Assessment Data Report". 1996
"Room Q Data Report: Test Borehole Data From December 7, 1993, through July 7, 1995". 1995

Attachment 1

Personal Profile: **Randy D. Elmore**
Position: **Cognizant System Engineer**
Confinement Ventilation Systems
Washington TRU Solutions LLC
WIPP Site

Summary:

Mr. Elmore is an engineer with over twenty years of experience with HVAC systems used for environmental, commercial and industrial applications including medical isolation suites, industrial clean room and laboratory and confinement ventilation systems. Experience includes the design, installation, start-up and oversight of isolation environments established through both positive and negative pressure differentials. Design activities have included not only air and equipment side but pneumatic, electronic and microprocessor design, programming, and start-up. Ancillary experiences and skills include cost estimation, project management, budgeting and system and personnel management.

Professional History:

Washington TRU Solutions, LLC. Carlsbad, New Mexico, 2001 – present:

Simplex Time Recorder, Inc., Lubbock, Texas, West Texas Marketing and Management Representative, 1998 to 2000

CSG (Compliance Services Group), Lubbock, Texas, Project Manager, 1996 to 1998

Con-Tech (Control Technologies), Lubbock, Texas, Co-Founder and Principal, 1992 to 1996

David G. Halley & Co., Inc., Lubbock, Texas, Sales Engineer / Stockholder, 1986 to 1992

Texas Instruments, Abilene, Texas, Project Engineer, 1985 to 1986

Williams, Tippet, and Associates, Inc., Abilene, Texas, Design Engineer, 1984 to 1985

Shell Pipeline Corp., Hamlin, Texas, Roustabout / Relief Technician, 1980 to 1982

Education:

B.S. in Mechanical Engineering, **Texas Tech University,** 1984 (Magna Cum Laude)

Professional Organizations:

Academy of Mechanical Engineers, Texas Tech University (Faculty Advisory Council, inducted April 2004)

Attachment 1

Personal Profile: **John J. Garcia**
Position: **Senior Manager**
Deputy Engineering Manager
Washington TRU Solutions LLC
WIPP Site

Summary

Proven executive level manager experienced in strategic planning, Program Management, Operations and Engineering management and business/product development of state-of-the-art nuclear facilities. Twenty-five plus years of progressive management experience. Proven ability to build new organizations, reorganize troubled organizations and expand into additional markets. Innovative problem solver and effective communicator adept in delivering superior customer service and developing new business.

Professional Experience:

Washington TRU Solutions, LLC, Carlsbad, NM – 6/1988 to Present

Deputy Engineering Manager (01/05 to Present)

- Management responsibility for implementation/improvement/maintenance of the site engineering and Nuclear Safety Programs.

Safety, Health, Security and Technical Support (02/03 to 01/05)

- Responsible for establishing and maintaining facility safety and health programs. Accomplished over 2 million work hours without a lost workday.
- Responsible for approximately 60 + employees and budget of 10 million.

Deputy Assistant General Manager Operations and Chief Engineer (02/01 to 02/03)

- Responsible for all site engineering issues listed under Engineering Manager
- Deputy Assistant General Manager Operations responsible for 400+ employees and budget of $80 Million.

Engineering Manager (Westinghouse Waste Isolation Division – 1995 to 2001)

- Responsible for 100+ employees and annual budget of $22 million.
- Assisted General Manager in establishing strategic direction and policy for the division.

- Managed an integrated, multi-disciplined infrastructure including business systems, multi-disciplined engineering functions, facility construction and configuration management processes.
- Maintained Nuclear Regulatory Commission package compliance and maintenance, generator site interface, transportation planning and tracking, Waste Acceptance Criteria requirements generation, and designed and maintained the WIPP Waste Information System for the National TRU (Transuranic Waste) Program.

Successive Engineering Management Positions including Manager, Program Management (1988-1995)

- Responsible for 35+ employees and budgets in excess of $12 million in preparation for start-up of the facility.
- Managed the division's budgeting and scheduling work scope.
- Integrated program details to establish current year budgets and five year planning.
- Tracked division performance and provided division support for program planning of major DOE or division initiatives.

Westinghouse Hanford Company, Hanford, WA – 1972 to1988

Engineering Positions of increasing responsibility leading to Manager, Waste Package, Repository and Seals Analysis Section

- Directed activities of 18 engineers and scientists and a budget of $4.5 million.
- Oversaw performance of critical engineering analyses and development of computer code to support design verification for the section.
- Designed software analytical packages for evaluating geotechnical, mechanical, hydrological, and thermal performance of the facility.

Education

B. S. - Mechanical Engineering, University of Texas, El Paso

Additional Master's Level Engineering courses

National Institute for Learning: "The Project Management Certificate Course"

Fluent in English and Spanish

Confinement Ventilation Documented Safety Analysis Information											
Facility: CH Surface CVS 411 HV01			Hazard Category 2					Performance Expectation			
Bounding Accidents	Type Confinement		Doses Bounding unmitigated / mitigated	Confinement Ventilation System Classification			Function DSA 4.3.x.1 or 4.4.x.1	Functional Requirements	Performance Requirements	Compensatory Measures	
	Active	Passive		SC	SS	DID					
(1-Fire) N/A	X		23.2 / N/A			X	N/A			Performance of Facility Evaluation did not revea any vulnerability . No Compensatory Measures required.	
(2 -Explosion) N/A	X		> 25 rem / Prevented			X	N/A			Performance of Facility Evaluation did not revea any vulnerability . No Compensatory Measures required.	
(3 _Loss of Containment / Confinement) N/A	X		3.1 / N/A			X	N/A			Performance of Facility Evaluation did not revea any vulnerability . No Compensatory Measures required.	
(4 -Direct Radiological / Chemical Exposure)	N/A		N/A			N/A	N/A			None Identified Based on Risk	
(5 -Nuclear Criticality)	N/A		N/A			N/A	N/A			Not credible for the WIPP due to WAC requirements/restrictions and established waste handling procedures/processes.	
(6 -External Hazards) N/A	X		N/A			X	N/A			Frequency of an aircraft crash iinto the WHB is Beyond Extremely Unlikely	
(7 -Natural Phenomena) N/A	X		23.2 rem / prevented			X	N/A			Performance of Facility Evaluation did not revea any vulnerability . No Compensatory Measures required.	

The identified Confinement Ventilation System provides Defense in Depth to accidents assoicated with operational and natural phenomenon events that could affect CH waste.

	Table 5-1 Ventilation System Performance Criteria **Facility: CH Surface CVS 411 HV01**				IRP assigned Performance Criteria For Evaluation: Safety Significant Hazard Category 2 - Active CVS
	Evaluation Criteria	Safety Sign. IRP Class	Discussion	Reference	Criteria met by
1	Pressure Differentials should be maintained between zones and atmosphere	Applies	Number of zones as credited by accident analysis to control hazardous release; demonstrate by use considering potential in-leakage	DOE-HDBK-1169 (2.2.9), ASHRAE Design Guide	The CVS is not credited in any analyzed accident scenario to control hazardous release. The CH ventilation is designed with different confinement zones established with cascading space pressure set points ,respective to atmosphere, established to control flow from areas of lower contamination to areas of higher contamination in accordance with guidance as established in DOE-HDBK-1169-2003, Chapter 2. Since all containers shipped to WIPP are certified to be free of external contamination and there is no plan to open the containers at WIPP, the DSA does not credit the confinement ventilation system for the prevention of release in any accident scenario.
2	Materials of Construction should be appropriate for normal, abnormal and accident conditions	Applies		DOE-HDBK-1169 (2.2.5), ASME AG-1	Provisions for accident and abnormal conditions have been considered in the construction of the CVS. Fans ducts and dampers are constructed of galvanized steel which is adequate based on the constituents that can reasonably be expected to exist in the air stream. The HEPA filter housings are fabricated of Stainless Steel to minimize the potential of corrosion on filter/housing interface surfaces and to aid in contamination clean-up should an accidental release occur. There is no reasonable expectation of corrosive fumes, spontaneous combustion, or explosion during processing. Waste is shipped to WIPP in sealed containers with regulated constituents regulated by the Waste Acceptance Criteria (WAC).
3	Exhaust system should withstand anticipated normal, abnormal and accident system conditions and maintain integrity	Applies	As required by accident analysis to prevent accident release	DOE-HDBK-1169 (2.4), ASHRAE Design Guide	The DSA does not credit the CVS in any prevention of accidental release. The system is designed to withstand anticipated normal, abnormal and accident conditions and maintain integrity. Explosions that would cause overpressure of the CVS is not a credible scenario based on the site processes and in place administrative controls (primarily the WAC). Fire propagation from a source to the filters is not a credible scenario based on the amount of combustibles present in the building, the non combustible materials of construction of the building and the non-combustible materials of construction of the CVS components (combustibles protected by the administratively controlled combustible loading program). Both Design Base Earthquake and Tornado considerations have been accounted for in the construction and operation of the WHB.
4	Confinement ventilation systems shall have appropriate filtration to minimize release	Applies	Address: 1) Type of filter (e.g., HEPA, sand, sintered metal); 2) Filter Sizing (flow capacity and pressure drop); 3) Decontamination Factor vs. accident analysis assumptions	ASME AG-1, DOE HDBK-1169 (2.2.1)	Filter quantity and size has been selected based on maximum flow rate through the HEPA media of 5 ft/min. The decontamination factor is of no consequence to the DSA since CVS is not credited for any accident scenarios. The waste handling process is relatively clean with minimal air borne particulate generated. Equipment is electrically powered and there are no machining or chemical process used that would generate significant amounts of particulate or gases. The single stage of prefilters is appropriate to prolong the life to the HEPA filters.

Table 5-1 Ventilation System Performance Criteria IRP assigned Performance Criteria For Evaluation: Safety Significant
Facility: CH Surface CVS 411 HV01 Hazard Category 2 - Active CVS

	Evaluation Criteria	Safety Sign. IRP Class	Discussion	Reference	Criteria met by
5	Provide system status instrumentation and/or alarms	Applies	Address key information to ensure system operability (e.g., system delta-P, filter pressure drop)	ASME AG-1, DOE-HDBK-1169, ASHRAE Design Guide (Section 4)	The HEPA filter housings are fitted with pressure monitoring capability for each HEPA filter bank with both local and remote readout. Remote alarms indicate a pressure drop that exceeds set point (alarm function is provided in the Central Monitoring Room (CMR)). WIPP has implemented a very conservative pressure drop limit of 5 inches w.g. for HEPA filter dp. Additional instrumentation provides local and remote indication of air flow with remote alarm in the CMR.
6	Interlock supply and exhaust fans to prevent positive pressure differential	Applies		DOE-HDBK-1169, ASHRAE Design Guide (Section 4)	Automated controls provide for interlock between the Supply Air units and the associated Exhaust Air Fans. On the loss of an exhaust fan, the associated supply air fan is shut down. Redundant exhaust air fan and supply air unit is automatically started when the lead ventilation set is "shut-down".
7	Post accident indication of filter break-through	Applies	Instrumentation supports post-accident planning and response	TECH-34	Local and remote indication of HEPA filter differential pressures and proof of air flow provide indication of filter status for post-accident planning and response.
8	Reliability of control system to maintain confinement function under normal, abnormal and accident conditions	Applies	Address, for example, impacts of potential common mode failures from events that would require active confinement function.	DOE-HDBK-1169 (2.4), ASHRAE Design Guide	The confinement ventilation system is comprised of two completely separate "trains" of equipment providing supply air flow, exhaust air flow and confinement filtration (supply fan, exhaust fan and HEPA filter unit). Each "train" is controlled through independent controls and instrumentation. Automated controls can be manually overridden at the local control panel. Common equipment such as space supply flow control and space pressure control via variable exhaust are designed to fail safe providing active confinement ventilation.
9	Control components should fail safe	Applies		DOE-HDBK-1169 (2.4)	Automated controls are designed to fail safe. Pressure Differential Dampers fail open. Local supply flow controls fail in the last controlled position. Exhaust system failure stops associated supply air. Failure of one "train" causes the automatic start of the back-up "train". Train controls can be manually overridden.
10	Confinement ventilation systems should withstand credible fire events and be available to operate and maintain confinement	Applies	As required by the accident analysis for existing facilities, must address protection of fiber media	DOE-HDBK-1169 (10.1), DOE-STD-1066	The DSA does not credit the HEPA filtration in the prevention of the release of hazardous materials. Fire propagation from a source to the filters is not a credible scenario based on the non combustible materials of construction of the building, the non-combustible materials of construction of the CVS components and the amount of combustibles present in the building (building loading of combustibles protected by the administratively controlled combustible loading program).
11	Confinement ventilation systems should not propagate the spread of fire	Applies	As required by the accident analysis for existing facilities, Address fire barriers, fire damper arrangements	DOE-HDBK-1169 (10.1), DOE-STD-1066	The building zones, the construction of the building and the site processes are such that fire dampers and fire suppression within the HEPA filter units is not required. Fans ducts and dampers are constructed of galvanized steel which is adequate based on the constituents that can reasonably be expected to exist in the air stream. Filters and filter housing are constructed of materials such as to not propagate the spread of a fire.

Table 5-1 Ventilation System Performance Criteria IRP assigned Performance Criteria For Evaluation: Safety Significant

Facility: CH Surface CVS 411 HV01 Hazard Category 2 - Active CVS

	Evaluation Criteria	Safety Sign. IRP Class	Discussion	Reference	Criteria met by
12	Confinement ventilation systems should safely withstand earthquakes	Applies	If the active CVS is not credited in a seismic accident condition, there is no need to evaluate that performance and/or design attribute for the CVS. Any seismic impact on the CVS will be based on the current functional requirements in the DSA	ASME AG-1 AA, DOE O420.1B, DOE-HDBK-1169 (9.2)	The elements of the CVS credited during a seismic event are the seismic/tornado dampers. These dampers are designed and installed in a manner to protect ventilation penetrations of the building envelope during a seismic event (close on seismic event). The closing of the dampers provides for the maintenance of the secondary confinement boundary provided by the building envelope during a seismic event.
13	Confinement ventilation system should safely withstand tornado depressurization	Applies	If the active CVS is not credited in a tornado condition, there is no need to evaluate that performance and/or design attribute for the CVS. Any tornado impact on the CVS will be based on the current functional requirements in the DSA	DOE O420.1B, DOE-HDBK-1169 (9.2)	The elements of the CVS credited during a tornado event are the seismic/tornado dampers. These dampers are designed and installed in a manner to protect ventilation penetrations of the building envelope during a tornado event (close on event). The closing of the dampers provides for the prevention of the rapid depressurization, caused by a tornado, from damaging the confinement barrier provided by the HEPA filters. Rapid depressurization of the exhaust system could cause the filters to be "sucked" through the housing if not properly protected. The tornado dampers are designed to provide that protection.
14	Confinement ventilation system should safely withstand design wind effects on system performance	Applies	If the CVS is not credited in a wind condition, there is no need to evaluate that performance and/or design attribute for the CVS. Any wind impact on the CVS performance will be based on the current NP analysis in the DSA	DOE O420.1B, DOE-HDBK-1169 (9.2)	The DSA does not credit the confinement ventilation system in the event of high winds. The CVS supply, exhaust and filtration systems are housed within the Waste Handling Building and therefore protected from the effects of reasonably assumed high wind events.
15	Confinement ventilation system should withstand other NP events considered credible in the DSA where the CVS is credited	Applies	If the CVS is not credited for this event, there is no need to evaluate that performance and/or design attribute for the CVS. Any impact on the CVS performance will be based on the current NP analysis in the DSA	DOE O420.1B, DOE-HDBK-1169 (9.2)	There are no other natural phenomenon events identified in the DSA which credit the CVS to prevent the release of hazardous materials.
16	Administrative controls should be established to protect confinement ventilation systems from barrier threatening events	Applies	Ensure appropriately thought out response to external threat is defined (e.g., pre-fire plan)	DOE O420.1B	The DSA describes measures that are implemented to protect the facility and structures from credible barrier threatening events at the facility level. The CVS systems are not specifically identified, however the administrative controls that are instituted to protect the facility provide CVS protection.
17	Design supports the periodic inspection and testing of filters and housing, and tests and inspections are conducted periodically	Applies	Ability to test for leakage per intent of N510	DOE-HDBK-1169 (2.3.8), ASME AG-1, ASME N510	WIPP utilizes a computerized history and maintenance planning system (CHAMPS) to track the performance and periodicity of confinement ventilation inspections and testing. System walk-downs are performed annually and aerosol penetration tests (in accordance with the intent of N510) are conducted on an annual basis per CHAMPS generated work orders.
18	Instrumentation required to support system operability is calibrated	Applies	Credited instrumentation should have specified calibration/surveillance requirements. Non-safety instrumentation should be calibrated as necessary to support system functionality.	DOE-HDBK-1169 (2.3.8)	No CVS instrumentation is credited in the DSA in the prevention of the release of hazardous materials in any accident scenario. WIPP utilizes the CHAMPS system and periodic maintenance work orders to generate and track the periodic calibration of instrumentation required to support the CVS operability.
19	Integrated system performance testing is specified and performed	Applies	required responses assumed in the accident analysis must be periodically confirmed including any time constraints	DOE-HDBK-1169 (2.3.8)	There are no CVS required responses in any DSA analyzed accident scenario.

	Table 5-1 Ventilation System Performance Criteria **Facility: CH Surface CVS 411 HV01**				IRP assigned Performance Criteria For Evaluation: Safety Significant Hazard Category 2 - Active CVS
	Evaluation Criteria	Safety Sign. IRP Class	Discussion	Reference	Criteria met by
20	Filter service life program should be established	Applies	Filter life (shelf life, service life, total life) expectancy should be determined. Consider filter environment, maximum delta-P, radiological loading, age, and potential chemical exposure.	DOE-STD-1169 (3.1 and Appendix C)	WIPP has instituted a filter service life program. Filters are being changed out to assure filters are no more than 10 years old. There is no significant source for potential chemical exposure, radiological exposure or other damaging environmental impacts to the filter media, housings or seals. WIPP has set a differential pressure limit of 5 inches water gauge across the filters. Filters are changed on age or filter pressure drop (which ever occurs first). Because the process and environment are so clean, WIPP has historically changed filters on age long before pressure drop became an issue.
21	Failure of one component (equipment or control) shall not affect continuous operation	Does Not Apply	Address potential failures (example failures-fan, back-up power supply, switchgear)	DOE O420.1B, Facility Safety, Chapter I, Sec. 3.b(8)	Although not applicable, continuous operation is supported through redundant equipment and fail safe configuration of common mode equipment. There is no single point failure in the CVS that will preclude continuous operation.
22	Automatic backup electrical power shall be provided to all critical instruments and equipment required to operate and monitor the CVS	Does Not Apply		DOE-HDBK-1169 (2.2.7)	Not applicable - see below
23	Backup electrical power shall be provided to all critical instruments and equipment required to operate and monitor the confinement ventilation system	Applies		DOE-HDBK-1169 (2.2.7)	The confinement ventilation system is powered through switch gear such that on a loss of availability of commercial power, the CVS, system critical instrumentation and associated monitoring equipment can be powered from the site diesel generators.
24	Address any specific functional requirements for the CVS (beyond the scope of those above) credited in the DSA	Applies		10 CFR 830, Subpart B	There are no additional CVS requirements credited by the DSA that have not been previously covered.

DOE Waste Isolation Pilot Plant

Contact Handled Underground Confinement Ventilation System VU01

Ventilation System Evaluation

Revision 0, October 25, 2007

Review and Approval Page

Site Lead:

Richard Farrell	Signature on File	Date: ____________

Evaluation Team Members:

Curtis A. Chester	Signature on File	Date: ____________
Randy D. Elmore	Signature on File	Date: ____________
John J. Garcia	Signature on File	Date: ____________

DOE Field Office Manager:

Dave Moody	Signature on File	Date: ____________

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Definitions

Safety Class.

Safety Class (SC) systems structures and components (SSCs) are those whose preventive or mitigative function is necessary to keep radiological material exposure to the public below the off-site evaluation guideline, which is 25 rem (roentgen equivalent man) total effective dose equivalent. The dose estimates to be compared to it are those received by a hypothetical maximally exposed off-site individual at the site boundary.

Safety Significant.

SSCs not designated as SC, but whose preventive or mitigative function is a major contributor to defense in depth (DiD) and/or worker safety as determined from hazards analysis. Safety Significant (SS) SSC designations based on worker safety are limited to those whose failure is estimated to result in a prompt worker fatality or serious injuries or significant radiological or chemical exposure to workers.

Waste Isolation Pilot Plant (WIPP) procedure WP 09-CN3023, *WIPP Functional Classification for Design*, Rev. 7 identifies greater than 100 rem to the worker as the consequence for requiring consideration for functionally classifying an SSC as SS.

Abbreviations and Acronyms

ALARA – As Low as Reasonably Achievable

CH – Contact Handled

Ci – Curie

CMR – Central Monitoring Room

CMS – Central Monitoring System

CVS – Confinement Ventilation System

DBE – Design Basis Earth Quake

DBT – Design Basis Tornado

DiD – Defense in Depth

DSA – Documented Safety Analysis

EG – Evaluation Guideline (25 rem TEDE to the maximally-exposed offsite individual as defined in DOE-STD-3009-94)

FET – Facility Evaluation Team as defined in the VSEG

HEPA – High Efficiency Particulate Air

IRP – Independent Review Panel as defined in the VSEG

PDD – Pressure Differential Damper

PE-Ci – Plutonium Equivalent Curies

PISA – Potentially Inadequate Safety Analysis

Pu-239 – Plutonium 239

rem – roentgen equivalent man

RH – Remote Handled

SC – Safety Class

SS – Safety Significant

SSCs – Systems, Structures and Components

SWB – Standard Waste Box

TEDE – Total Effective Dose Equivalent

TDOP – Ten Drum Over Pack

UG – Underground

VSEG – Department of Energy, Deliverables 8.5.4 and 8.7 of Implementation Plan for Defense Nuclear Facilities Safety Board Recommendation 2004-2, *Ventilation System Evaluation Guidance for Safety-Related and Non-Safety-Related Systems*

WIPP – Waste Isolation Pilot Plant

Executive Summary:

The Waste Isolation Pilot Plant (WIPP) site is a low level repository for radioactive waste. Waste is characterized and shipped to WIPP in packages for disposal in the repository. The container that the waste is packaged in prior to loading into transportation containers (road casks) provides primary containment. There is no planned normal operation at WIPP that allows for waste to be present external to the waste package container primary containment. The waste container packages that are used for disposal are removed from the transportation containers (road casks) in the Waste Handling Building (WHB). From the time the packages are removed until they are placed in the repository, the packages are contained within facilities and structures with active confinement ventilation systems.

The field evaluation team (FET) used the independent review panel (IRP) directed functional classification criteria for safety significant (SS). Based on the evaluation criteria, the confinement ventilation system (CVS) evaluation did not reveal any "gaps" in the installed system's functional design or performance expectations. The installed system's functional design and performance expectations is commensurate with the identified site mission of receiving prepackaged and characterized waste and emplacing the waste in the waste container packages in which the waste is received on site. During the evaluation of the systems functional design and performance expectations against the evaluation criteria and the facility Documented Safety Analysis (DSA), there was no discovery of a potentially inadequate safety analysis (PISA).

Introduction

Facility Overview

The WIPP is located in Eddy County in southeastern New Mexico. The WIPP is located in an area of low population density with no industrial, commercial, institutional, recreational or residential structures within the WIPP Site Boundary.

The WIPP is designed to receive and handle 500,000 cubic feet per year (ft^3/yr) (14,160 cubic meters per year [m^3/yr]) Contact Handled (CH) waste and 10,000 ft3/yr (283 m^3/yr) Remote Handled (RH) waste. The WIPP facility is designed to have a disposal capacity for TRU waste of 6.2 million ft^3 (175,600 m^3). The WIPP facility has sufficient capacity to handle the 250,000 ft^3 (7,080 m^3) of RH waste. The WIPP is divided into surface structures, shafts, and subsurface structures.

The WIPP surface structures accommodate the personnel, equipment, and support services required for the receipt, preparation, and transfer of waste from the surface to the underground (UG). Vertical shafts, including the waste shaft, the salt handling shaft, the exhaust shaft, and the air intake shaft, extend from the surface to the UG horizon. The waste shaft is located between the CH and RH areas in the WHB.

The WIPP UG consists of the waste disposal area, construction area, north area, and the waste shaft station area. The CH and RH waste disposal area is a 100 acre area on a horizon located 2,150 feet beneath the surface in a deep, bedded salt formation.

CH waste is disposed of in the rooms and panel entries of each room. CH waste arrives to the WIPP in drum assemblies, Standard Waste Boxes (SWBs), or Ten Drum Over-packs (TDOPs). Drum assemblies and SWBs are stacked three high, and may be intermixed within rows and columns. TDOPs are placed on the bottom row. Four-packs of 85-gallon drums and three-packs of 100-gallon drums are placed on top of assemblies of the same type or placed on the top row for stability.

The hazard classification category was determined in accordance with DOE-STD-1027-92. The material at risk for the determination of the categorization was defined as the maximum radiological contents of a single 55-gallon drum of CH waste at 80 plutonium-239 equivalent curies (PE-Ci). Since this inventory exceeds the Hazard Category 2 minimum threshold of 56 Ci for Pu-239, the WIPP is categorized as a Hazard Category 2 facility.

Confinement Ventilation Strategy

The UG ventilation system serves the WIPP UG to provide acceptable working conditions and a life-sustaining environment during normal operations and off normal events including waste handling accidents. All equipment and components of the CH UG CVS are located on the surface and provide ventilation to the UG through the mine exhaust shaft. In the event of a breach of waste containers, the UG ventilation system provides air flow away from the worker. Upon the detection of air borne radioactivity or the notification of a radiation control event, the ventilation system is either automatically or can be manually switched to provide high efficiency particulate air (HEPA) filtration of the mine exhaust.

The UG ventilation system is designed as an exhausting system that maintains the working environment below atmospheric pressure. The UG mine ventilation is designed to supply sufficient quantities of air to all areas of the repository. UG ventilation is divided into four separate flow paths supporting the waste disposal area, the construction area, north area, and the waste shaft station. All four air circuits combine near the exhaust shaft, which acts as the common discharge from the underground. A pressure differential is maintained between the construction circuit and the waste disposal circuit to ensure that any leakage is towards the disposal circuit. The pressure differential is produced by the surface exhaust fans in conjunction with the underground air regulators. Pressure differentials across selected bulkheads between ventilation circuits are monitored from the Central Monitoring Room (CMR).

The UG ventilation system consists of six centrifugal exhaust fans (three main fans in the normal flow path and three smaller fans in the filtration flow path), two identical HEPA filter assemblies arranged in parallel, isolation and back draft dampers, a filter bypass arrangement, and associated ductwork. The main fans are used during normal operation to provide a nominal underground flow. During filtration operations only one filtration fan is in service and all other main and filtration fans are stopped and isolated. Any one of the three filtration fans is capable of delivering 100 percent of the design flow rate with the HEPA filters at their maximum pressure drop. The UG ventilation system is operated as follows:

- Normal Mode - During normal operation, five different levels of ventilation can be established to provide five different air flow quantities.
- Filtration Mode - This mode mitigates the consequences of a waste handling accident releasing radioactive contamination to the environment by providing a HEPA filtered air exhaust path from the underground and also reducing the air flow.

Filtration is activated automatically on a high radiation signal from one of the continuous air monitors in the exhaust of the active disposal room, or manually by the CMR operator, through the central monitoring system (CMS), when notified of a waste handling event underground. The operating status of the exhaust fans are displayed in the CMR and provisions to switch to filtration are provided. An alarm for excessive pressure drop across the filters is actuated at a predetermined level. Filter differential pressure is displayed locally and in the CMR. Instruments and system components are accessible for periodic testing and inspection during normal plant operation.

Under normal operating conditions, the ventilation system functions continuously. The UG ventilation system filtration fans can be connected to the backup power supply, one at a time, in the event that normal power is lost. Air is routed through the individual disposal rooms within a panel using UG bulkheads and air regulators.

Each HEPA filter assembly that serves the UG is equipped with two banks of prefilters and two banks of HEPA filters. All nuclear grade HEPA filter banks are tested for conformance with ASME N510.

The system was installed in stages starting in the mid 1980s. Originally the smaller exhaust filtration fans were installed. Two of the larger main fans were installed in the early 1990s with the third main fan installed in 1996 – 1997. The original design information is maintained and available at WIPP.

Major Modifications

The facility is not currently undergoing any major modifications that affect the ventilation system or its operation.

Functional Classification Assessment

The WIPP procedure WP 09-CN3023, WIPP Functional Classification for Design, is the site procedure used for functional classification.

Existing Classification

Based on site procedures the CH UG CVS of this evaluation is classified as a SS system. This CVS is credited in the site DSA for preventing prompt, significant radiological or chemical exposure to workers.

Evaluation

The FET used the proceduralized site process, WP 09-CN3023, to evaluate the existing site functional classification of the CVS evaluated. Additionally, the FET reviewed the site procedure for compliance with DOE regulations and drivers to assess that the site procedure provides adequate assessment of functional classification for site systems.

The CH UG CVS was found to have the proper existing functional classification per WP 09-CN3023.

The procedure, WP 09-CN3023, was found to be inline with the DOE-STD-3009-94 guidance for functional classification. The FET did discover one typographical error in the procedure. The typographical error is being corrected.

Summary

The existing facility CH UG CVS functional classification is appropriate. The system provides ventilation required for industrial safety issues and directs airflow away from the workers in various DSA analyzed accident scenarios.

System Evaluation

Identification of Gaps

The FET identified there were no gaps between the *Ventilation System Evaluation Guidance for Safety-Related and Non-Safety-Related Systems* (VSEG) evaluation criteria and the installed system's functional design or performance expectations.

The FET used the IRP directed SS performance criteria for the evaluation in accordance with the guidance in section 5.1 of the document from the VSEG. Section 5.1 identifies that all hazard category 2 nuclear facilities that do not challenge or exceed the evaluation guideline (EG) will utilize SS performance criteria as identified in Table 5-1 of the VSEG.

The evaluation verified all the VSEG established performance criteria for SS CVS systems were adequately met by the CVS. The criteria established to be mandatory for this evaluation were:

a. Materials of Construction should be appropriate for normal, abnormal and accident conditions.
b. Confinement ventilation systems shall have appropriate filtration to minimize release.
c. Provide system status instrumentation and/or alarms.
d. Post accident indication of filter break-through.
e. Reliability of control system to maintain confinement function under normal, abnormal and accident conditions.
f. Control components should fail safe.
g. Administrative controls should be in place to protect confinement ventilation systems from barrier threatening events.
h. Design supports periodic inspection and testing of filters and housing, and tests and inspections are conducted periodically.
i. Filter service life program should be established.
j. Failure of one component (equipment or control) shall not affect continuous operation.
k. Backup electrical power shall be provided to all critical instruments and equipment to operate and monitor the CVS.

The above listed criteria are required for the system to adequately provide the DSA credited safety significant system function.

All other IRP established VSEG performance criteria, identified in Table 5-1 of the VSEG, were determined non-mandatory. The non-mandatory criteria were identified within the VSEG to be "applicable as required" or "credited by the facility DSA". The facility DSA does not credit the CH UG CVS to prevent or control hazardous release in the accident analyses.

Gap Evaluation

The FET identified there were no gaps between the VSEG evaluation criteria and the installed system's functional design or performance expectations, whether mandatory or non-mandatory.

Modifications and Upgrades

There are no required modifications or upgrade to the CH UG CVS since there are no gaps between the established performance criteria and the installed system's functional design or performance expectations.

Conclusion

The FET performed an evaluation of the CH UG CVS. The result of the evaluation was a determination that the system's installed design and performance expectations met the evaluation performance criteria established by the VSEG IRP for a Hazard Category 2 facility. There were no findings or proposed corrective actions as a result of this evaluation.

While there are no modifications or upgrades required, the system equipment is subject to a corrosive environment. There are corrosion and salt accumulations issues that will require attention for the life of the facility. These issues are being managed and continue to be managed through proper maintenance and equipment refurbishment.

References

ASME N510 — American Society of Mechanical Engineers, 1989, *Standard for Testing of Nuclear Air Cleaning Systems*, (formerly ANSI N510-1975, ANSI/ASME N510-1989)

CH DSA — DOE/WIPP-95-2065, REVISION 10, NOVEMBER 2006, Waste Isolation Pilot Plant Contact Handled (CH) Waste Documented Safety Analysis, with approved page changes CH-2007-01 and CH-2007-02, August 27, 2007

DOE-STD-3009-94 — DOE Standard Preparation Guide for U.S Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses, with Change Notice No. 2, April 2002

DOE-STD-1027-92 DOE Standard, Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports, with Change Notice No. 1, September 1997

DOE HDBK-1169-2003 DOE Handbook, Nuclear Air Cleaning Handbook

RH DSA DOE/WIPP-06-3174, REVISION 0, MARCH 2006, Waste Isolation Pilot Plant Remote Handled (RH) Waste Documented Safety Analysis, with page changes approved through August 28, 2007

SDD VU00 U.S. Department of Energy, Waste Isolation Pilot Plant, Underground Ventilation System Design Description, Rev. 12

WP 09-CN3023 *WIPP Functional Classification for Design*, Rev. 7

Attachments

Facility Evaluation Team composition and biographical sketches

Attachment 1 – FET members' Personnel Profiles

Data Collection Table and supporting attachments

Attachment 2 – Data Collection Table

Table 4-3

Attachment 3 - Supporting Attachments

CH Underground CVS VU01, Table 5-1 Ventilation System Performance Criteria and Evaluation Response

Summary Schedules for implementing upgrades

Not applicable – no identified "gaps" or required upgrades

Completed supporting evaluations and documentation

Not applicable.

Attachment 1

Field Evaluation Team Personal Profiles Page

Attachment 1

Personal Profile: **Richard F. Farrell**
Position: **Nuclear Safety Specialist**
U. S. DOE Carlsbad Field Office
(505) 234-8318

Summary:

1. Environmental, Safety, and Health (E,S&H) professional with over 30 years of diversified experience in nuclear and industrial safety, health physics, environmental/effluent monitoring, regulatory compliance related to state-of-the-art nuclear facilities, and mining and mineral extraction/ metallurgical processing.
2. Managed the development of the Waste Isolation Pilot Plant (WIPP) documented safety analysis (DSA) for contact-handled and remote-handled transuranic (CH/RH-TRU) waste disposal operations. Developed and the Department of Energy's (DOE) safety evaluation reports (SER) or approval bases associated with the WIPP safety basis.
3. Developed and managed the Radioactive Source Materials License compliance programs for a NRC licensed facility (an operating uranium mill/mine) including: radiological and industrial safety, ALARA, quality assurance, occupational health, and underground mine ventilation engineering and monitoring.

Experience:

U. S. Department of Energy; September 2007 - Present
Nuclear Safety Specialist Carlsbad Field Office (CBFO) Responsibilities include oversight and integration of CBFO/WIPP radiological and nuclear safety, occupational health, and nuclear safety management.
Safety Officer CBFO; August 2000 – September 2007 Responsibilities include oversight and integration of CBFO/WIPP industrial, radiological and nuclear safety, and occupational health.

U. S. Department of Energy; September 1992 - August 2000
Radiological Safety Manager Carlsbad Area Office (CAO) Responsibilities include oversight and management of CAO/WIPP radiological safety/control programs (10 CFR Part 835) and nuclear safety management (10 CFR Part 830).

Westinghouse Electric Corporation; April 1990 - September 1992
Senior Engineer at the Waste Isolation Pilot Plant Responsibilities include the management of interface activities with oversight and auditing groups, evaluation of applicable regulations and DOE orders, and support of audits of waste generator sites with regard to waste acceptance criteria.

Homestake Mining Company; 1977 - April 1990
(Nuclear Regulatory Licensed Uranium Milling and Mining)
Environmental Safety and Health Department On-Site Manage; 1983 - April 1990
Responsible for radiation safety/health programs as the radiation safety officer (RSO) for the Nuclear Regulatory Commission (NRC) licensed facility. Responsibilities included department administration, industrial safety/health, emergency management, RCRA compliance and hazardous waste management, CERCLA remediation and monitoring activities, occupational health and regulatory compliance.

Attachment 1

Radiation Protection Administrator; 1980 - 1983 Responsibilities included management of the health physics, oand hazardous waste activities, training, environmental and effluent monitoring, and regulatory compliance. Served as the RSO for a NRC licensed facility.
Radiological Safety/Environmental Engineer; 1977 - 1980 Responsibilities included evaluation of radiological safety, health physics assessment, monitoring data, and the development of monitoring and emission control programs to assure compliance with occupational and environmental regulations.

Education:

B.S. - Chemistry major - biology minor, Northern Arizona University, 1975.
Twelve (12) semester hours of graduate level chemistry class work, and six (6) semester hours of graduate level radioactive waste management; University of New Mexico; 1981 and 1992, respectively.
Strong background in applied mathematics and statistics equivalent to a minor area of study [twenty (20) semester hours], Brigham Young University; 1993 - 1996.

Attachment 1

Personal Profile: **Curtis A. Chester**
Position: **Engineering Manager**
Integrated Waste Handling Engineering
Washington TRU Solutions LLC
WIPP Site

Summary:

Mr. Chester is the Washington TRU Solutions manager of the Integrated Waste Handling Engineering (IWHE) group. IWHE is responsible for the technical ownership of all equipment used in the waste handling process, both Contact Handled and Remote Handled. Mr. Chester's staff consists of 17 engineers engaged in oversight of systems that include such diverse applications of engineering as robotics in waste processing, radiological monitoring systems, pumping and distributions systems for fire suppression, industrial material handling systems, facility structural integrity (including seismic and tornado loading) and confinement ventilation. The IWHE group is tasked with monitoring, maintaining, designing and planning the implementation of regulatory requirements associated with aspects of safety, environmental and radiological requirements for the site waste handling process. As manager of the IWHE group, Mr. Chester is responsible for administration of the proper oversight, review and approval of the actions implemented by the group.

Mr. Chester has participated in two successful Operational Readiness Reviews while at WIPP and was the lead engineer in the successful completion of the Remote Handled readiness review completed in January of 2007 including the system Start-up Testing and the system Line Management Assessment. Mr. Chester's experience and accomplishments in mechanical design, shop fabrication, procurement, engineering application of quality control and application of industrial process control make him uniquely suited for management of the IWHE group.

Professional History:

Manager / Integrated Waste Handling Engineering (1998 to present)
WGI/ Washington TRU solutions Carlsbad, New Mexico
Management of personnel employed in the development and implementation of strategies, resource allocations, baselines, and project execution plans for package handling equipment, system upgrades, and processes supporting the disposal of Defense Nuclear Waste. Successes and competence have been identified with a continuous progression of assignments from support engineer to engineering staff management.

Project Engineer / Staff Consultant (1993 to 1997)
Duke Engineering & Services Carlsbad, New Mexico
Provide design, analysis, and project management services to engineering and maintenance staff at the Waste Isolation Pilot Plant (WIPP).

Product Integrity Engineer/ Lead Manufacturing Engineer (1990 to 1993)
Martin Marietta Corporation Albuquerque, New Mexico
Develop and maintain process flow instructions and configuration management for multiple process lines. Conduct engineering analysis on mechanical structures and assemblies. Develop and implement quality, cost effective manufacturing practices regarding station layouts, sequence of operations, and tooling requirements.

Staff Engineer (1989-1990, 1993)

Attachment 1

Pharmacia SP Albuquerque, New Mexico
Perform engineering analysis on equipment. Develop equipment enhancements. Design and prototype special devices.

Education:

B.S. in Mechanical Engineering, **UNM Albuquerque, NM,** 1989

Publications:

"Final Results of the WIPP RH TRU Facility Shielding Analysis". 2002
"Exhaust Shaft Hydraulic Assessment Data Report". 1996
"Room Q Data Report: Test Borehole Data From December 7, 1993, through July 7, 1995". 1995

Attachment 1

Personal Profile: **Randy D. Elmore**
Position: **Cognizant System Engineer**
Confinement Ventilation Systems
Washington TRU Solutions LLC
WIPP Site

Summary:

Mr. Elmore is an engineer with over twenty years of experience with HVAC systems used for environmental, commercial and industrial applications including medical isolation suites, industrial clean room and laboratory and confinement ventilation systems. Experience includes the design, installation, start-up and oversight of isolation environments established through both positive and negative pressure differentials. Design activities have included not only air and equipment side but pneumatic, electronic and microprocessor design, programming, and start-up. Ancillary experiences and skills include cost estimation, project management, budgeting and system and personnel management.

Professional History:

Washington TRU Solutions, LLC. Carlsbad, New Mexico, 2001 – present:

Simplex Time Recorder, Inc., Lubbock, Texas, West Texas Marketing and Management Representative, 1998 to 2000

CSG (Compliance Services Group), Lubbock, Texas, Project Manager, 1996 to 1998

Con-Tech (Control Technologies), Lubbock, Texas, Co-Founder and Principal, 1992 to 1996

David G. Halley & Co., Inc., Lubbock, Texas, Sales Engineer / Stockholder, 1986 to 1992

Texas Instruments, Abilene, Texas, Project Engineer, 1985 to 1986

Williams, Tippet, and Associates, Inc., Abilene, Texas, Design Engineer, 1984 to 1985

Shell Pipeline Corp., Hamlin, Texas, Roustabout / Relief Technician, 1980 to 1982

Education:

B.S. in Mechanical Engineering, **Texas Tech University,** 1984 (Magna Cum Laude)

Professional Organizations:

Academy of Mechanical Engineers, Texas Tech University (Faculty Advisory Council, inducted April 2004)

Attachment 1

Personal Profile: **John J. Garcia**
Position: **Senior Manager**
Deputy Engineering Manager
Washington TRU Solutions LLC
WIPP Site

Summary

Proven executive level manager experienced in strategic planning, Program Management, Operations and Engineering management and business/product development of state-of-the-art nuclear facilities. Twenty-five plus years of progressive management experience. Proven ability to build new organizations, reorganize troubled organizations and expand into additional markets. Innovative problem solver and effective communicator adept in delivering superior customer service and developing new business.

Professional Experience:

Washington TRU Solutions, LLC, Carlsbad, NM – 6/1988 to Present

Deputy Engineering Manager (01/05 to Present)

- Management responsibility for implementation/improvement/maintenance of the site engineering and Nuclear Safety Programs.

Safety, Health, Security and Technical Support (02/03 to 01/05)

- Responsible for establishing and maintaining facility safety and health programs. Accomplished over 2 million work hours without a lost workday.
- Responsible for approximately 60 + employees and budget of 10 million.

Deputy Assistant General Manager Operations and Chief Engineer (02/01 to 02/03)

- Responsible for all site engineering issues listed under Engineering Manager
- Deputy Assistant General Manager Operations responsible for 400+ employees and budget of $80 Million.

Engineering Manager (Westinghouse Waste Isolation Division – 1995 to 2001)

- Responsible for 100+ employees and annual budget of $22 million.
- Assisted General Manager in establishing strategic direction and policy for the division.

- Managed an integrated, multi-disciplined infrastructure including business systems, multi-disciplined engineering functions, facility construction and configuration management processes.
- Maintained Nuclear Regulatory Commission package compliance and maintenance, generator site interface, transportation planning and tracking, Waste Acceptance Criteria requirements generation, and designed and maintained the WIPP Waste Information System for the National TRU (Transuranic Waste) Program.

Successive Engineering Management Positions including Manager, Program Management (1988-1995)

- Responsible for 35+ employees and budgets in excess of $12 million in preparation for start-up of the facility.
- Managed the division's budgeting and scheduling work scope.
- Integrated program details to establish current year budgets and five year planning.
- Tracked division performance and provided division support for program planning of major DOE or division initiatives.

Westinghouse Hanford Company, Hanford, WA – 1972 to1988

Engineering Positions of increasing responsibility leading to Manager, Waste Package, Repository and Seals Analysis Section

- Directed activities of 18 engineers and scientists and a budget of $4.5 million.
- Oversaw performance of critical engineering analyses and development of computer code to support design verification for the section.
- Designed software analytical packages for evaluating geotechnical, mechanical, hydrological, and thermal performance of the facility.

Education

B. S. - Mechanical Engineering, University of Texas, El Paso

Additional Master's Level Engineering courses

National Institute for Learning: "The Project Management Certificate Course"

Fluent in English and Spanish

Confinement Ventilation Documented Safety Analysis Information											
Facility: CH U/G VU01			Hazard Category 2					Performance Expectation			
Bounding Accidents	Type Confinement		Doses Bounding unmitigated / mitigated	Confinement Ventilation System Classification			Function	Functional Requirements	Performance Requirements	Compensatory Measures	
	Active	Passive		SC	SS	DID					
(1-Fire) N/A	X		> 25 rem / prevented		X		In-facility worker protection	Required to provide sufficient airflow to direct airflow away from workers during waste handling in the event of a waste container breach. Sufficient airflow must also be maintained to facilitate evacuation of underground workers in the event of underground fires. The underground ventilation system is required to provide at least 20,000 scfm at the base of the waste shaft and 42,000 scfm in the active disposal room	The TSRs require daily check of the minimum airflow in active disposal room and in the waste shaft ventilation circuit	Fires are prevented by equipment fire suppression systems and Administrative Controls listed in Section 3.4.2.2.5 of the CH DSA. Similar credits are identified in the RH DSA.	
(2 -Explosion) N/A	X		> 25 rem / prevented		X		In-facility worker protection	Required to provide sufficient airflow to direct airflow away from workers during waste handling in the event of a waste container breach. Sufficient airflow must also be maintained to facilitate evacuation of underground workers in the event of underground fires. The underground ventilation system is required to provide at least 20,000 scfm at the base of the waste shaft and 42,000 scfm in the active disposal room	The TSRs require daily check of the minimum airflow in active disposal room and in the waste shaft ventilation circuit	Performance of Facility Evaluation did not reveal any vulnerability . No Compensatory Measures required.	
(3 _Loss of Containment / Confinement) N/A	X		> 25 rem / prevented		X		In-facility worker protection	Required to provide sufficient airflow to direct airflow away from workers during waste handling in the event of a waste container breach. Sufficient airflow must also be maintained to facilitate evacuation of underground workers in the event of underground fires. The underground ventilation system is required to provide at least 20,000 scfm at the base of the waste shaft and 42,000 scfm in the active disposal room	The TSRs require daily check of the minimum airflow in active disposal room and in the waste shaft ventilation circuit	Performance of Facility Evaluation did not reveal any vulnerability . No Compensatory Measures required.	
(4 -Direct Radiological / Chemical Exposure)	N/A		N/A				N/A	N/A		None Identified Based on Risk	
(5 -Nuclear Criticality)	N/A		N/A				N/A	N/A		Not credible for the WIPP due to WAC requirements/restrictions and established waste handling procedures/processes.	
(6 -External Hazards) N/A	X		N/A				N/A	N/A		Performance of Facility Evaluation did not reveal any vulnerability . No Compensatory Measures required.	
(7 -Natural Phenomena) N/A	X		> 25 rem / prevented		X		In-facility worker protection	Required to provide sufficient airflow to direct airflow away from workers during waste handling in the event of a waste container breach. Sufficient airflow must also be maintained to facilitate evacuation of underground workers in the event of underground fires. The underground ventilation system is required to provide at least 20,000 scfm at the base of the waste shaft and 42,000 scfm in the active disposal room	The TSRs require daily check of the minimum airflow in active disposal room and in the waste shaft ventilation circuit	Performance of Facility Evaluation did not reveal any vulnerability . No Compensatory Measures required.	

The identified Confinement Ventilation System provides Defense in Depth to accidents assoicated with operational and natural phenomenon events that could affect CH waste.

	Table 5-1 Ventilation System Performance Criteria **Facility: CH U/G CVS VU01**			IRP assigned Performance Criteria For Evaluation: Safety Significant Hazard Category 2 - Active CVS	
	Evaluation Criteria	Safety Sign. IRP Class	Discussion	Reference	Criteria met by
1	Pressure Differentials should be maintained between zones and atmosphere	Applies	Number of zones as credited by accident analysis to control hazardous release; demonstrate by use considering potential in-leakage	DOE-HDBK-1169 (2.2.9), ASHRAE Design Guide	Pressure differentials are validated by measured flow rate. Flow rate validated with each change of ventilation control setting. Flow rates are verified no less than once per shift
2	Materials of Construction should be appropriate for normal, abnormal and accident conditions	Applies		DOE-HDBK-1169 (2.2.5), ASME AG-1	The Mine drifts themselves serve as the underground air flow conduits. The 8 gauge surface duct, structural supports and fans are adequately constructed.
3	Exhaust system should withstand anticipated normal, abnormal and accident system conditions and maintain integrity	Applies	As required by accident analysis to prevent accident release	DOE-HDBK-1169 (2.4), ASHRAE Design Guide	WIPP ground control measures assures adequate underground integrity. There is no accident scenario that will impact the system integrity except for natural phenomenon (NP). The only DSA identified accident scenarios that can effect the surface fans and ducts of the CVS are NP and are addressed in the following.
4	Confinement ventilation systems shall have appropriate filtration to minimize release	Applies	Address: 1) Type of filter (e.g., HEPA, sand, sintered metal); 2) Filter Sizing (flow capacity and pressure drop); 3) Decontamination Factor vs. accident analysis assumptions	ASME AG-1, DOE HDBK-1169 (2.2.1)	WIPP underground filtration is provided by two 7 wide by 3 high HEPA filter housing (24"x24" filters). Each housing is rated for 30,000 cfm. The air flow is reduced to 60,000 cfm during filtration. Mine exhaust air flow is not normally directed through the filters. This allows the filters to be kept clean and dry.
5	Provide system status instrumentation and/or alarms	Applies	Address key information to ensure system operability (e.g., system delta-P, filter pressure drop)	ASME AG-1, DOE-HDBK-1169, ASHRAE Design Guide (Section 4)	The HEPA filter housings are fitted with pressure monitoring capability for each HEPA filter bank with both local and remote readout. Remote alarms indicate a pressure drop that exceeds set point (alarm function is provided in the Central Monitoring Room (CMR)). WIPP has implemented a very conservative pressure drop limit of 5 inches w.g. for HEPA filter dp. Additional instrumentation provides local and remote indication of air flow with remote alarm in the CMR.
6	Interlock supply and exhaust fans to prevent positive pressure differential	Applies		DOE-HDBK-1169, ASHRAE Design Guide (Section 4)	The underground ventilation system is a draw through ventilation system without supply fans. Natural ventilation pressure (NVP) can cause very slight ventilation pressures differentials at certain points in the mine. However, NVP is not an issue in the emplacement room or the waste face. The emplacement room and the waste face are the areas of concern from the credited DSA perspective.
7	Post accident indication of filter break-through	Applies	Instrumentation supports post-accident planning and response	TECH-34	Local and remote indication of HEPA filter differential pressures and proof of air flow provide indication of filter status for post-accident planning and response.

	Table 5-1 Ventilation System Performance Criteria **Facility: CH U/G CVS VU01**			IRP assigned Performance Criteria For Evaluation: Safety Significant Hazard Category 2 - Active CVS	
	Evaluation Criteria	Safety Sign. IRP Class	Discussion	Reference	Criteria met by
8	Reliability of control system to maintain confinement function under normal, abnormal and accident conditions	Applies	Address, for example, impacts of potential common mode failures from events that would require active confinement function.	DOE-HDBK-1169 (2.4), ASHRAE Design Guide	The confinement ventilation system is comprised of three separate exhaust fans for normal (700 fans) and three separate fans for filtration (860 fans) air flow. The 700 and 860 fans can be ran in multiple configurations. Each fan has its own control system. The two filter housings that are employed during filtration events are parallel. Common isolation dampers have manual override capability and dual dampers to provide system redundancy to reduce the risk to site operations due to equipment outages. The extensive equipment redundancy provides for high availability of equipment to support operations thus providing reliable operation in normal, accident and abnormal operations.
9	Control components should fail safe	Applies		DOE-HDBK-1169 (2.4)	Isolation dampers are configured to fail safe providing underground confinement of any release of materials from the repository should a release occur during the event of equipment failure. The failure of any other CVS control component will not affect the system integrity.
10	Confinement ventilation systems should withstand credible fire events and be available to operate and maintain confinement	Applies	As required by the accident analysis for existing facilities, must address protection of fiber media	DOE-HDBK-1169 (10.1), DOE-STD-1066	There is no accident analysis associated with fire events that would render the filter media ineffective for confinement. The filter media is approximately one-half mile from the repository area where credible fire events could take place. The HEPA filters are housed inside a all metal filter housing in a building of non-combustible construction without significant sources of ignition or fire source material in the immediate vicinity.
11	Confinement ventilation systems should not propagate the spread of fire	Applies	As required by the accident analysis for existing facilities, Address fire barriers, fire damper arrangements	DOE-HDBK-1169 (10.1), DOE-STD-1066	The filters and housing are of non-combustible construction. While the ventilation flow can support the sustaining of a fire in the underground, the air flow is required to support evacuation. The structure of the mine (chloride salt and clay) is non-combustible and the greatest hazard to the workers in a fire event is smoke. Ventilation flow and evacuation procedures for the mine are established to minimize the hazard to the workers. Ventilation flow can be controlled from the surface. The Facility Shift Manager (or designee) is responsible for emergency response operations which are established to provide the safest operational configuration in protection of the public, the workers and the environment.
12	Confinement ventilation systems should safely withstand earthquakes	Applies	If the active CVS is not credited in a seismic accident condition, there is no need to evaluate that performance and/or design attribute for the CVS. Any seismic impact on the CVS will be based on the current functional requirements in the DSA	ASME AG-1 AA, DOE O420.1B, DOE-HDBK-1169 (9.2)	The system is not credited in the DSA to prevent the release of industrially or radiologically hazardous materials in the event of an earthquake.

	Table 5-1 Ventilation System Performance Criteria **Facility: CH U/G CVS VU01**			IRP assigned Performance Criteria For Evaluation: Safety Significant	Hazard Category 2 - Active CVS
	Evaluation Criteria	Safety Sign. IRP Class	Discussion	Reference	Criteria met by
13	Confinement ventilation system should safely withstand tornado depressurization	Applies	If the active CVS is not credited in a tornado condition, there is no need to evaluate that performance and/or design attribute for the CVS. Any tornado impact on the CVS will be based on the current functional requirements in the DSA	DOE O420.1B, DOE-HDBK-1169 (9.2)	The system is not credited in the DSA to prevent the release of industrially or radiologically hazardous materials in the event of a tornado.
14	Confinement ventilation system should safely withstand design wind effects on system performance	Applies	If the CVS is not credited in a wind condition, there is no need to evaluate that performance and/or design attribute for the CVS. Any wind impact on the CVS performance will be based on the current NP analysis in the DSA	DOE O420.1B, DOE-HDBK-1169 (9.2)	The system is not credited in the DSA to prevent the release of industrially or radiologically hazardous materials in the event of a high wind condition.
15	Confinement ventilation system should withstand other NP events considered credible in the DSA where the CVS is credited	Applies	If the CVS is not credited for this event, there is no need to evaluate that performance and/or design attribute for the CVS. Any impact on the CVS performance will be based on the current NP analysis in the DSA	DOE O420.1B, DOE-HDBK-1169 (9.2)	There are no other natural phenomenon events identified in the DSA which credit the CVS to prevent the release of hazardous materials.
16	Administrative controls should be established to protect confinement ventilation systems from barrier threatening events	Applies	Ensure appropriately thought out response to external threat is defined (e.g., pre-fire plan)	DOE O420.1B	The DSA describes measures that are implemented to protect the facility and structures from credible barrier threatening events at the facility level. The CVS systems are not specifically identified, however the administrative controls that are instituted to protect the facility provide CVS protection.
17	Design supports the periodic inspection and testing of filters and housing, and tests and inspections are conducted periodically	Applies	Ability to test for leakage per intent of N510	DOE-HDBK-1169 (2.3.8), ASME AG-1, ASME N510	WIPP utilizes a computerized history and maintenance planning system (CHAMPS) to track the performance and periodicity of confinement ventilation inspections and testing. System walk-downs are performed annually and aerosol penetration tests (in accordance with the intent of N510) are conducted on an annual basis per CHAMPS generated work orders.
18	Instrumentation required to support system operability is calibrated	Applies	Credited instrumentation should have specified calibration/surveillance requirements. Non-safety instrumentation should be calibrated as necessary to support system functionality.	DOE-HDBK-1169 (2.3.8)	No CVS instrumentation is credited in the DSA in the prevention of the release of hazardous materials in any accident scenario. WIPP utilizes the CHAMPS system and periodic maintenance work orders to generate and track the periodic calibration of instrumentation required to support the CVS operability. The shift-to-filtration operation of the CVS is checked quarterly.

	Table 5-1 Ventilation System Performance Criteria **Facility: CH U/G CVS VU01**			IRP assigned Performance Criteria For Evaluation: Safety Significant Hazard Category 2 - Active CVS	
	Evaluation Criteria	Safety Sign. IRP Class	Discussion	Reference	Criteria met by
19	Integrated system performance testing is specified and performed	Applies	required responses assumed in the accident analysis must be periodically confirmed including any time constraints	DOE-HDBK-1169 (2.3.8)	There are no CVS required responses in any DSA analyzed accident scenario. The shift-to-filtration operation of the CVS is checked quarterly.
20	Filter service life program should be established	Applies	Filter life (shelf life, service life, total life) expectancy should be determined. Consider filter environment, maximum delta-P, radiological loading, age, and potential chemical exposure.	DOE-STD-1169 (3.1 and Appendix C)	WIPP has instituted a filter service life program. Filters are being changed out to assure filters are no more than 10 years old. There is no significant source for potential chemical exposure, radiological exposure or other damaging environmental impacts to the filter media, housings or seals. WIPP has set a differential pressure limit of 5 inches water gauge across the filters. Filters are changed on age or filter pressure drop (which ever occurs first). Because the process and environment is so clean, WIPP has historically changed filters on age long before pressure drop became an issue.
21	Failure of one component (equipment or control) shall not affect continuous operation	Does Not Apply	Address potential failures (example failures- fan, back-up power supply, switchgear)	DOE O420.1B, Facility Safety, Chapter I, Sec. 3.b(8)	Although not applicable, equipment redundancy (fans) and manual control operation of both fans and dampers allow for continued operation with any single point failure. The fans used for HEPA filtration can be powered from site generators on a loss of commercially available power.
22	Automatic backup electrical power shall be provided to all critical instruments and equipment required to operate and monitor the CVS	Does Not Apply		DOE-HDBK-1169 (2.2.7)	Not applicable.
23	Backup electrical power shall be provided to all critical instruments and equipment required to operate and monitor the confinement ventilation system	Applies		DOE-HDBK-1169 (2.2.7)	The fans used for HEPA filtration, system critical instrumentation and associated monitoring equipment can be powered from site generators on a loss of commercially available power.
24	Address any specific functional requirements for the CVS (beyond the scope of those above) credited in the DSA	Applies		10 CFR 830, Subpart B	There are no additional CVS requirements credited by the DSA that have not been previously covered.

DOE Waste Isolation Pilot Plant

Remote Handled Surface Confinement Ventilation System 411 HV02

Ventilation System Evaluation

Revision 0, October 25, 2007

Review and Approval Page

Site Lead:

Richard Farrell	___Signature on File_____	Date: ___________

Evaluation Team Members:

Curtis A. Chester	___Signature on File_____	Date: ___________
Randy D. Elmore	___Signature on File_____	Date: ___________
John J. Garcia	___Signature on File_____	Date: ___________

DOE Field Office Manager:

Dave Moody	___Signature on File_____	Date: ___________

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Definitions

Safety Class.

Safety Class (SC) systems structures and components (SSCs) are those whose preventive or mitigative function is necessary to keep radiological material exposure to the public below the off-site evaluation guideline, which is 25 rem (roentgen equivalent man) total effective dose equivalent. The dose estimates to be compared to it are those received by a hypothetical maximally exposed off-site individual at the site boundary.

Safety Significant.

SSCs not designated as SC, but whose preventive or mitigative function is a major contributor to defense in depth (DiD) and/or worker safety as determined from hazards analysis. Safety Significant (SS) SSC designations based on worker safety are limited to those whose failure is estimated to result in a prompt worker fatality or serious injuries or significant radiological or chemical exposure to workers.

Waste Isolation Pilot Plant (WIPP) procedure WP 09-CN3023, *WIPP Functional Classification for Design*, Rev. 7 identifies greater than 100 rem to the worker as the consequence for requiring consideration for functionally classifying an SSC as SS.

Abbreviations and Acronyms

ALARA – As Low as Reasonably Achievable

CH – Contact Handled

Ci – Curie

CMR – Central Monitoring Room

CMS – Central Monitoring System

CVS – Confinement Ventilation System

DBE – Design Basis Earth Quake

DBT – Design Basis Tornado

DiD – Defense in Depth

DSA – Documented Safety Analysis

EG – Evaluation Guideline (25 rem TEDE to the maximally-exposed offsite individual as defined in DOE-STD-3009-94)

FET – Facility Evaluation Team as defined in the VSEG

HEPA – High Efficiency Particulate Air

IRP – Independent Review Panel as defined in the VSEG

PDD – Pressure Differential Damper

PE-Ci – Plutonium Equivalent Curies

PISA – Potentially Inadequate Safety Analysis

Pu-239 – Plutonium 239

rem – roentgen equivalent man

RH – Remote Handled

SC – Safety Class

SS – Safety Significant

SSCs – Systems, Structures and Components

TEDE – Total Effective Dose Equivalent

VSEG – Department of Energy, Deliverables 8.5.4 and 8.7 of Implementation Plan for Defense Nuclear Facilities Safety Board Recommendation 2004-2, *Ventilation System Evaluation Guidance for Safety-Related and Non-Safety-Related Systems*

WIPP – Waste Isolation Pilot Plant

Executive Summary:

The Waste Isolation Pilot Plant (WIPP) site is a low level repository for radioactive waste. Waste is characterized and shipped to WIPP in packages for disposal in the repository. The container that the waste is packaged in prior to loading into transportation containers (road casks) provides primary containment. There is no planned normal operation at WIPP that allow for waste to be present external to the waste package container primary containment. The waste container packages that are used for disposal are removed from the transportation containers (road casks) in the Waste Handling Building (WHB). From the time the packages are removed until they are placed in the repository, the packages are contained within facilities and structures with active confinement ventilation systems.

Remote Handled (RH) surface waste handling operations are performed in the RH portion of the WHB. The Remote Handled Confinement Ventilation System (CVS) 411 HV02 provides the active CVS for the RH surface waste handling operations. This system is not credited in the site Documented Safety Analysis (DSA) analyzed accident scenario to control hazardous release. The evaluated CVS performs a defense-in-depth (DiD) function for the WIPP site. WIPP is a Hazard Category 2 facility. The facility evaluation team (FET) used the independent review panel (IRP) directed functional classification criteria for SS. Based on the evaluation criteria, the system evaluation did not reveal any "gaps" in the installed system's functional design or performance expectations. The installed system's functional design and performance expectations is commensurate with the identified site mission of receiving prepackaged and characterized waste and emplacing the waste in the waste container packages in which the waste is received on site. During the evaluation of the systems functional design and performance expectations against the evaluation criteria and the facility DSA, there was no discovery of a potentially inadequate safety analysis (PISA).

Introduction

Facility Overview

The WIPP is located in Eddy County in southeastern New Mexico. The WIPP is located in an area of low population density with no industrial, commercial, institutional, recreational or residential structures within the WIPP Site Boundary.

The WIPP is designed to receive and handle 500,000 cubic feet per year (ft^3/yr) (14,160 cubic meters per year [m^3/yr]) CH waste and 10,000 ft3/yr (283 m^3/yr) RH waste. The WIPP facility is designed to have a disposal capacity for TRU waste of 6.2 million ft^3 (175,600 m^3). The WIPP facility has sufficient capacity to handle the 250,000 ft^3 (7,080 m^3) of RH waste. The WIPP is divided into surface structures, shafts, and subsurface structures

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The WIPP surface structures accommodate the personnel, equipment, and support services required for the receipt, preparation, and transfer of waste from the surface to the underground. The primary surface operations at the WIPP are conducted in the WHB, which is divided into the CH waste handling area, the RH waste handling area, and support areas.

Vertical shafts, including the waste shaft, the salt handling shaft, the exhaust shaft, and the air intake shaft, extend from the surface to the underground horizon. The waste shaft is located between the CH and RH areas in the WHB.

The WIPP underground consists of the waste disposal area, construction area, north area, and the waste shaft station area. The CH and RH waste disposal area is a 100 acre area on a horizon located 2,150 feet beneath the surface in a deep, bedded salt formation.

RH waste is shipped to the site in one of two types of road casks. Waste canisters are shipped in 72-B casks. Drums of waste are shipped in 10-160B casks. Waste canisters shipped in 72-B casks are nominally 10 feet long and 26 inches in diameter. Drums of waste received in 10-160B casks, are over-packed into a steel facility canisters in the Hot Cell. Facility canisters are nominally 10 feet long and 28 inches in diameter. Canisters of RH waste are emplaced in the bore holes drilled in the walls of the disposal rooms.

The hazard classification category was determined in accordance with DOE-STD-1027-92. The material at risk for the determination of the categorization was defined as the maximum radiological contents of a single 55-gallon drum of CH waste at 80 plutonium-239 equivalent curies (PE-Ci). Since this inventory exceeds the Hazard Category 2 minimum threshold of 56 Ci for Pu-239, the WIPP is categorized as a Hazard Category 2 facility.

Confinement Ventilation Strategy

The WIPP CVS are designed to provide confinement barriers utilizing high efficiency particulate air (HEPA) filtration to limit releases of airborne radioactive contaminants. Exhaust stacks are designed with elevated discharges and fresh air supply intakes located away from the exhaust vents. The RH portion of the WHB has two ventilation systems, one for the RH bay and the other for the hot cell complex. Each system maintains pressure differential between areas of low potential for airborne radioactive material and those of higher potential. The RH bay ventilation system has HEPA filters located in the WHB mechanical equipment room, while the hot cell complex ventilation system HEPA filters are located in a room adjacent to the lower hot cell. The hot cell ventilation system ensures that the upper hot cell remains at a lower static pressure than other RH areas of the WHB. The ventilation supply and exhaust systems for each WHB subsystem supply air to the rooms of the areas served. Each supply air handling unit consists of filters, cooling coils, heating elements, fans with associated duct work, and controls to condition the supply air maintaining the design temperature during winter and summer. Fan operating status, filter bank pressure drops, and static pressure differentials can be monitored locally and in the central monitoring room (CMR). Excess filter pressure drop and loss of flow alarm in the CMR. Instruments and system components are accessible for, and will be subject to, periodic testing and inspection during normal plant operation.

The WHB ventilation systems continuously filter the exhaust air from waste handling areas to reduce the potential for release of radioactive effluents to the environment. Airlocks for ventilation differential pressure control are electrically interlocked and are provided in the following locations:

- Between areas of large pressure differences to provide a pressure transition and to eliminate high air velocity
- Between areas where pressure differentials must be maintained
- To minimize air movement from the WHB to the waste shaft

The ventilation systems include monitoring of the following operating parameters:

- Pressure drop across each pre-filter and HEPA filter bank
- Air flow rates at selected points
- Pressure differentials surrounding areas of high potential for contamination levels

The WHB supply and exhaust fans are designed and interlocked to maintain building pressure negative with respect to atmospheric pressure and maintain the design air flow pattern. During normal operation, if the operating exhaust/supply fan fail, the corresponding supply/exhaust fan is stopped. The standby train is started automatically and can also be started manually.

The WHB exhaust fans and controls can be supplied by backup power in the event that normal power is interrupted. In case of an off-site power failure, the capability exists to selectively switch one exhaust fan to the backup power system.

The Station C effluent sampling system continuously samples the air discharged from the WHB exhaust vent downstream of HEPA filtration. Tornado dampers, constructed to withstand the design basis earthquake (DBE) and design basis tornado (DBT), are installed in all heating ventilation and air conditioning inlet and exhaust openings in the WHB. In the event of a tornado, the WHB tornado dampers will automatically close to prevent the outward rush of air caused by a rapid drop in atmospheric pressure. Damper closure mitigates damage to HEPA filters from a potential high differential pressure.

The filtration system consists of prefilters and HEPA filters sized in accordance with design air flows utilizing industry standards for maximum efficiency. All nuclear grade HEPA filter banks are tested for conformance with ASME N510.

The RH surface CVS equipment was installed in the WHB facility in the mid 1980's. Between 2000 and 2002, the pneumatic control system was replaced with a microprocessor based distributive control system. Constant volume terminal units were installed in the supply system to enhance the stability of the space pressure. The original design information is still maintained and available via site records.

Currently an air recirculation modification is in progress. This is not a major modification. Duct and dampers have been installed to allow air within specific zones to be recirculated. The related control system is not yet functional and is awaiting a window of opportunity for deployment. The recirculation modification is being installed in accordance with DOE-HDBK-1169-2003 guidance and recommendations. The recirculation modification will not negatively impact system confinement capabilities or As Low as Reasonably Achievable (ALARA) principals. The Hot Cell exhaust will not be recirculated.

Major Modifications

The facility is not currently undergoing any major modifications that affect the ventilation system or its operation.

Functional Classification Assessment

The WIPP procedure WP 09-CN3023, WIPP Functional Classification for Design, is the site procedure used for functional classification.

Existing Classification

Based on site procedures the RH surface CVS of this evaluation is classified as a balance of plant system providing a DiD function. This CVS is not credited in the facility DSA for providing a safety class or safety significant function.

Evaluation

The FET used the proceduralized site process, WP 09-CN3023, to evaluate the existing site functional classification of the CVS evaluated. Additionally, the FET reviewed the site procedure for compliance with DOE regulations and drivers to assess that the site procedure provides adequate assessment of functional classification for site systems.

The procedure, WP 09-CN3023, was found to be inline with the DOE-STD-3009-94 guidance for functional classification. The FET did discover one typographical error in the procedure. The error is being corrected.

Summary

The existing facility functional classification is commensurate with the identified site mission of receiving prepackaged and characterized waste and emplacing the waste in the packages in which it was received, in the site repository.

System Evaluation

Identification of Gaps

The FET identified there were no gaps between the *Ventilation System Evaluation Guidance for Safety-Related and Non-Safety-Related Systems* (VSEG) evaluation criteria and the installed system's functional design or performance expectations.

The FET used the IRP directed SS performance criteria for the evaluation in accordance with the guidance in section 5.1 of the VSEG. Section 5.1 identifies that all hazard category 2 nuclear facilities that do not challenge or exceed the evaluation guideline (EG) will utilize SS performance criteria as identified in Table 5-1 of the VSEG.

The evaluation verified all the VSEG established performance criteria for SS CVS systems were adequately met by the CVS. The criteria established to be mandatory for this evaluation were:

a. Materials of Construction should be appropriate for normal, abnormal and accident conditions.
b. Confinement ventilation systems shall have appropriate filtration to minimize release.
c. Provide system status instrumentation and/or alarms.

d. Interlock supply and exhaust fans to prevent positive pressure differential.
e. Post accident indication of filter break-through.
f. Reliability of control system to maintain confinement function under normal, abnormal and accident conditions.
g. Control components should fail safe.
h. Administrative controls should be in place to protect confinement ventilation systems from barrier threatening events.
i. Design supports periodic inspection and testing of filters and housing, and tests and inspections are conducted periodically.
j. Filter service life program should be established.
k. Failure of one component (equipment or control) shall not affect continuous operation.
l. Backup electrical power shall be provided to all critical instruments and equipment to operate and monitor the CVS.

The above listed criteria are required for the system to adequately provide mitigative DiD performance.

All other IRP established VSEG performance criteria, identified in Table 5-1 of the VSEG, were non-mandatory. The non-mandatory criteria were identified within the VSEG to be "applicable as required" or "credited by the facility DSA". The facility DSA does not credit the RH surface CVS to prevent or control hazardous release in the accident analyses.

Gap Evaluation

The FET identified there were no gaps between the VSEG evaluation criteria and the installed system's functional design or performance expectations, whether mandatory or non-mandatory.

Modifications and Upgrades

There are no required modifications or upgrade to the RH surface CVS as there are no gaps between the established performance criteria and the installed system's functional design or performance expectations.

Conclusion

The FET performed an evaluation of the RH surface CVS. The result of the evaluation was a determination that the system's installed design and performance expectations met the evaluation performance criteria established by the VSEG IRP for a Hazard Category 2 facility. There were no findings or proposed corrective actions as a result of this evaluation.

The FET did identify the opportunity to enhance pressure differential damper (PDD) control component reliability by the installation of additional controllers at specific PDDs. The identified item is not a mandated change and is recognized as an opportunity for enhancement to be processed and scheduled based on site priorities.

References

ASME N510	American Society of Mechanical Engineers, 1989, *Standard for Testing of Nuclear Air Cleaning Systems*, (formerly ANSI N510-1975, ANSI/ASME N510-1989)
CH DSA	DOE/WIPP-95-2065, REVISION 10, NOVEMBER 2006, Waste Isolation Pilot Plant Contact Handled (CH) Waste Documented Safety Analysis, with approved page changes CH-2007-01 and CH-2007-02, August 27, 2007
DOE-STD-3009-94	DOE Standard Preparation Guide for U.S Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses, with Change Notice No. 2, April 2002
DOE-STD-1027-92	DOE Standard, Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports, with Change Notice No. 1, September 1997
DOE HDBK-1169-2003	DOE Handbook, Nuclear Air Cleaning Handbook
RH DSA	DOE/WIPP-06-3174, REVISION 0, MARCH 2006, Waste Isolation Pilot Plant Remote Handled (RH) Waste Documented Safety Analysis, with page changes approved through August 28, 2007
SDD HV00	U.S. Department of Energy, Waste Isolation Pilot Plant, Heating, Ventilation and Air Conditioning System, System Design Description (SDD), Rev. 10
WP 09-CN3023	*WIPP Functional Classification for Design*, Rev. 7

Attachments

Facility Evaluation Team composition and biographical sketches

Attachment 1 – FET members' Personnel Profiles

Data Collection Table and supporting attachments

Attachment 2 – Data Collection Table

Table 4-3

Attachment 3 - Supporting Attachments

RH Surface CVS 411 HV02, Table 5-1 Ventilation System Performance Criteria and Evaluation Response

Summary Schedules for implementing upgrades

Not applicable – no identified "gaps" or required upgrades

Completed supporting evaluations and documentation

Not applicable.

Attachment 1

Field Evaluation Team Personal Profiles | Page

Attachment 1

Personal Profile: **Richard F. Farrell**
Position: **Nuclear Safety Specialist**
U. S. DOE Carlsbad Field Office
(505) 234-8318

Summary:

1. Environmental, Safety, and Health (E,S&H) professional with over 30 years of diversified experience in nuclear and industrial safety, health physics, environmental/effluent monitoring, regulatory compliance related to state-of-the-art nuclear facilities, and mining and mineral extraction/ metallurgical processing.
2. Managed the development of the Waste Isolation Pilot Plant (WIPP) documented safety analysis (DSA) for contact-handled and remote-handled transuranic (CH/RH-TRU) waste disposal operations. Developed and the Department of Energy's (DOE) safety evaluation reports (SER) or approval bases associated with the WIPP safety basis.
3. Developed and managed the Radioactive Source Materials License compliance programs for a NRC licensed facility (an operating uranium mill/mine) including: radiological and industrial safety, ALARA, quality assurance, occupational health, and underground mine ventilation engineering and monitoring.

Experience:

U. S. Department of Energy; September 2007 - Present
Nuclear Safety Specialist Carlsbad Field Office (CBFO) Responsibilities include oversight and integration of CBFO/WIPP radiological and nuclear safety, occupational health, and nuclear safety management.
Safety Officer CBFO; August 2000 – September 2007 Responsibilities include oversight and integration of CBFO/WIPP industrial, radiological and nuclear safety, and occupational health.

U. S. Department of Energy; September 1992 - August 2000
Radiological Safety Manager Carlsbad Area Office (CAO) Responsibilities include oversight and management of CAO/WIPP radiological safety/control programs (10 CFR Part 835) and nuclear safety management (10 CFR Part 830).

Westinghouse Electric Corporation; April 1990 - September 1992
Senior Engineer at the Waste Isolation Pilot Plant Responsibilities include the management of interface activities with oversight and auditing groups, evaluation of applicable regulations and DOE orders, and support of audits of waste generator sites with regard to waste acceptance criteria.

Homestake Mining Company; 1977 - April 1990
(Nuclear Regulatory Licensed Uranium Milling and Mining)
Environmental Safety and Health Department On-Site Manage; 1983 - April 1990
Responsible for radiation safety/health programs as the radiation safety officer (RSO) for the Nuclear Regulatory Commission (NRC) licensed facility. Responsibilities included department administration, industrial safety/health, emergency management, RCRA compliance and hazardous waste management, CERCLA remediation and monitoring activities, occupational health and regulatory compliance.

Radiation Protection Administrator; 1980 - 1983 Responsibilities included management of the health physics, oand hazardous waste activities, training, environmental and effluent monitoring, and regulatory compliance. Served as the RSO for a NRC licensed facility.
Radiological Safety/Environmental Engineer; 1977 - 1980 Responsibilities included evaluation of radiological safety, health physics assessment, monitoring data, and the development of monitoring and emission control programs to assure compliance with occupational and environmental regulations.

Education:

B.S. - Chemistry major - biology minor, Northern Arizona University, 1975.
Twelve (12) semester hours of graduate level chemistry class work, and six (6) semester hours of graduate level radioactive waste management; University of New Mexico; 1981 and 1992, respectively.
Strong background in applied mathematics and statistics equivalent to a minor area of study [twenty (20) semester hours], Brigham Young University; 1993 - 1996.

Attachment 1

Personal Profile: **Curtis A. Chester**
Position: **Engineering Manager**
Integrated Waste Handling Engineering
Washington TRU Solutions LLC
WIPP Site

Summary:

Mr. Chester is the Washington TRU Solutions manager of the Integrated Waste Handling Engineering (IWHE) group. IWHE is responsible for the technical ownership of all equipment used in the waste handling process, both Contact Handled and Remote Handled. Mr. Chester's staff consists of 17 engineers engaged in oversight of systems that include such diverse applications of engineering as robotics in waste processing, radiological monitoring systems, pumping and distributions systems for fire suppression, industrial material handling systems, facility structural integrity (including seismic and tornado loading) and confinement ventilation. The IWHE group is tasked with monitoring, maintaining, designing and planning the implementation of regulatory requirements associated with aspects of safety, environmental and radiological requirements for the site waste handling process. As manager of the IWHE group, Mr. Chester is responsible for administration of the proper oversight, review and approval of the actions implemented by the group.

Mr. Chester has participated in two successful Operational Readiness Reviews while at WIPP and was the lead engineer in the successful completion of the Remote Handled readiness review completed in January of 2007 including the system Start-up Testing and the system Line Management Assessment. Mr. Chester's experience and accomplishments in mechanical design, shop fabrication, procurement, engineering application of quality control and application of industrial process control make him uniquely suited for management of the IWHE group.

Professional History:

Manager / Integrated Waste Handling Engineering (1998 to present)
WGI/ Washington TRU solutions Carlsbad, New Mexico
Management of personnel employed in the development and implementation of strategies, resource allocations, baselines, and project execution plans for package handling equipment, system upgrades, and processes supporting the disposal of Defense Nuclear Waste. Successes and competence have been identified with a continuous progression of assignments from support engineer to engineering staff management.

Project Engineer / Staff Consultant (1993 to 1997)
Duke Engineering & Services Carlsbad, New Mexico
Provide design, analysis, and project management services to engineering and maintenance staff at the Waste Isolation Pilot Plant (WIPP).

Product Integrity Engineer/ Lead Manufacturing Engineer (1990 to 1993)
Martin Marietta Corporation Albuquerque, New Mexico
Develop and maintain process flow instructions and configuration management for multiple process lines. Conduct engineering analysis on mechanical structures and assemblies. Develop and implement quality, cost effective manufacturing practices regarding station layouts, sequence of operations, and tooling requirements.

Staff Engineer (1989-1990, 1993)

Attachment 1

Pharmacia SP Albuquerque, New Mexico
Perform engineering analysis on equipment. Develop equipment enhancements. Design and prototype special devices.

Education:

B.S. in Mechanical Engineering, **UNM Albuquerque, NM,** 1989

Publications:

"Final Results of the WIPP RH TRU Facility Shielding Analysis". 2002
"Exhaust Shaft Hydraulic Assessment Data Report". 1996
"Room Q Data Report: Test Borehole Data From December 7, 1993, through July 7, 1995". 1995

Attachment 1

Personal Profile: **Randy D. Elmore**
Position: **Cognizant System Engineer**
Confinement Ventilation Systems
Washington TRU Solutions LLC
WIPP Site

Summary:

Mr. Elmore is an engineer with over twenty years of experience with HVAC systems used for environmental, commercial and industrial applications including medical isolation suites, industrial clean room and laboratory and confinement ventilation systems. Experience includes the design, installation, start-up and oversight of isolation environments established through both positive and negative pressure differentials. Design activities have included not only air and equipment side but pneumatic, electronic and microprocessor design, programming, and start-up. Ancillary experiences and skills include cost estimation, project management, budgeting and system and personnel management.

Professional History:

Washington TRU Solutions, LLC. Carlsbad, New Mexico, 2001 – present:

Simplex Time Recorder, Inc., Lubbock, Texas, West Texas Marketing and Management Representative, 1998 to 2000

CSG (Compliance Services Group), Lubbock, Texas, Project Manager, 1996 to 1998

Con-Tech (Control Technologies), Lubbock, Texas, Co-Founder and Principal, 1992 to 1996

David G. Halley & Co., Inc., Lubbock, Texas, Sales Engineer / Stockholder, 1986 to 1992

Texas Instruments, Abilene, Texas, Project Engineer, 1985 to 1986

Williams, Tippet, and Associates, Inc., Abilene, Texas, Design Engineer, 1984 to 1985

Shell Pipeline Corp., Hamlin, Texas, Roustabout / Relief Technician, 1980 to 1982

Education:

B.S. in Mechanical Engineering, **Texas Tech University,** 1984 (Magna Cum Laude)

Professional Organizations:

Academy of Mechanical Engineers, Texas Tech University (Faculty Advisory Council, inducted April 2004)

Attachment 1

Personal Profile: **John J. Garcia**
Position: **Senior Manager**
Deputy Engineering Manager
Washington TRU Solutions LLC
WIPP Site

Summary

Proven executive level manager experienced in strategic planning, Program Management, Operations and Engineering management and business/product development of state-of-the-art nuclear facilities. Twenty-five plus years of progressive management experience. Proven ability to build new organizations, reorganize troubled organizations and expand into additional markets. Innovative problem solver and effective communicator adept in delivering superior customer service and developing new business.

Professional Experience:

Washington TRU Solutions, LLC, Carlsbad, NM – 6/1988 to Present

Deputy Engineering Manager (01/05 to Present)

- Management responsibility for implementation/improvement/maintenance of the site engineering and Nuclear Safety Programs.

Safety, Health, Security and Technical Support (02/03 to 01/05)

- Responsible for establishing and maintaining facility safety and health programs. Accomplished over 2 million work hours without a lost workday.
- Responsible for approximately 60 + employees and budget of 10 million.

Deputy Assistant General Manager Operations and Chief Engineer (02/01 to 02/03)

- Responsible for all site engineering issues listed under Engineering Manager
- Deputy Assistant General Manager Operations responsible for 400+ employees and budget of $80 Million.

Engineering Manager (Westinghouse Waste Isolation Division – 1995 to 2001)

- Responsible for 100+ employees and annual budget of $22 million.
- Assisted General Manager in establishing strategic direction and policy for the division.

- Managed an integrated, multi-disciplined infrastructure including business systems, multi-disciplined engineering functions, facility construction and configuration management processes.
- Maintained Nuclear Regulatory Commission package compliance and maintenance, generator site interface, transportation planning and tracking, Waste Acceptance Criteria requirements generation, and designed and maintained the WIPP Waste Information System for the National TRU (Transuranic Waste) Program.

Successive Engineering Management Positions including Manager, Program Management (1988-1995)

- Responsible for 35+ employees and budgets in excess of $12 million in preparation for start-up of the facility.
- Managed the division's budgeting and scheduling work scope.
- Integrated program details to establish current year budgets and five year planning.
- Tracked division performance and provided division support for program planning of major DOE or division initiatives.

Westinghouse Hanford Company, Hanford, WA – 1972 to1988

Engineering Positions of increasing responsibility leading to Manager, Waste Package, Repository and Seals Analysis Section

- Directed activities of 18 engineers and scientists and a budget of $4.5 million.
- Oversaw performance of critical engineering analyses and development of computer code to support design verification for the section.
- Designed software analytical packages for evaluating geotechnical, mechanical, hydrological, and thermal performance of the facility.

Education

B. S. - Mechanical Engineering, University of Texas, El Paso

Additional Master's Level Engineering courses

National Institute for Learning: "The Project Management Certificate Course"

Fluent in English and Spanish

Confinement Ventilation Documented Safety Analysis Information										
Facility: RH Surface CVS 411 HV02			Hazard Category 2					Performance Expectation		
Bounding Accidents	Type Confinement		Doses Bounding unmitigated / mitigated	Confinement Ventilation System Classification			Function	Functional Requirements	Performance Requirements	Compensatory Measures
	Active	Passive		SC	SS	DID				
(1-Fire) N/A	X		> 25 rem / prevented			X	N/A			Performance of Facility Evaluation did not reveal any vulnerability . No Compensatory Measures required.
(2 -Explosion) N/A	X		> 25 rem / prevented			X	N/A			Performance of Facility Evaluation did not reveal any vulnerability . No Compensatory Measures required.
(3 _Loss of Containment / Confinement)	X		6.0 / N/A			X	N/A			Performance of Facility Evaluation did not reveal any vulnerability . No Compensatory Measures required.
(4 -Direct Radiological / Chemical Exposure)	N/A		N/A			N/A	N/A			None Identified Based on Risk
(5 -Nuclear Criticality)	N/A		N/A			N/A	N/A			Not credible for the WIPP due to WAC requirements/restrictions and established waste handling procedures/processes.
(6 -External Hazards) N/A	X		N/A			X	N/A			Frequency of an aircraft crash iinto the WHB is Beyond Extremely Unlikely
(7 -Natural Phenomena) N/A	X		> 25 rem / prevented			X	N/A			Performance of Facility Evaluation did not reveal any vulnerability . No Compensatory Measures required.

The identified Confinement Ventilation System provides Defense in Depth to accidents assoicated with operational and natural phenomenon events that could affect RH waste.

Table 5-1 Ventilation System Performance Criteria IRP assigned Performance Criteria For Evaluation: Safety Significant
Facility: RH Surface CVS 411 HV02 Hazard Category 2 - Active CVS

	Evaluation Criteria	Safety Sign. IRP Class	Discussion	Reference	Criteria met by
1	Pressure Differentials should be maintained between zones and atmosphere	Applies	Number of zones as credited by accident analysis to control hazardous release; demonstrate by use considering potential in-leakage	DOE-HDBK-1169 (2.2.9), ASHRAE Design Guide	The CVS is not credited in any analyzed accident scenario to control hazardous release. The RH ventilation is designed with different confinement zones established with cascading space pressure set points ,respective to atmosphere, established to control flow from areas of lower contamination to areas of higher contamination in accordance with guidance as established in DOE-HDBK-1169-2003, Chapter 2. The RH bay is held equal to atmosphere. The Hot Cell complex is held at a more negative pressure and the Upper Hot Cell is held at the most negative pressure. Since all containers shipped to WIPP are certified to be free of external contamination and there is no plan to open the containers at WIPP, the DSA does not credit the confinement ventilation system for the prevention of release in any accident scenario.
2	Materials of Construction should be appropriate for normal, abnormal and accident conditions	Applies		DOE-HDBK-1169 (2.2.5), ASME AG-1	Provisions for accident and abnormal conditions have been considered in the construction of the CVS. Fans ducts and dampers are constructed of galvanized steel which is adequate based on the constituents that can reasonably be expected to exist in the air stream. The HEPA filter housings are fabricated of Stainless Steel to minimize the potential of corrosion on filter/housing interface surfaces and to aid in contamination clean-up should an accidental release occur. There is no reasonable expectation of corrosive fumes, spontaneous combustion, or explosion during processing. Waste is shipped to WIPP in sealed containers with regulated constituents regulated by the Waste Acceptance Criteria (WAC).
3	Exhaust system should withstand anticipated normal, abnormal and accident system conditions and maintain integrity	Applies	As required by accident analysis to prevent accident release	DOE-HDBK-1169 (2.4), ASHRAE Design Guide	The DSA does not credit the CVS in any prevention of accidental release. The system is designed to withstand anticipated normal, abnormal and accident conditions and maintain integrity. Explosions that would cause overpressure of the CVS is not a credible scenario based on the site processes and in place administrative controls (primarily the WAC). Fire propagation from a source to the filters is not a credible scenario based on the amount of combustibles present in the building, the non combustible materials of construction of the building and the non-combustible materials of construction of the CVS components (combustibles protected by the administratively controlled combustible loading program). Both Design Base Earthquake and Tornado considerations have been accounted for in the construction and operation of the WHB.
4	Confinement ventilation systems shall have appropriate filtration to minimize release	Applies	Address: 1) Type of filter (e.g., HEPA, sand, sintered metal); 2) Filter Sizing (flow capacity and pressure drop); 3) Decontamination Factor vs. accident analysis assumptions	ASME AG-1, DOE HDBK-1169 (2.2.1)	Filter quantity and size has been selected based on maximum flow rate through the HEPA media of 5 ft/min. The decontamination factor is of no consequence to the DSA since CVS is not credited for any accident scenarios. The waste handling process is relatively clean with minimal air borne particulate generated. Some minimal amount of diesel particulate could possibly enter the RH Bay as the Road Cask is located in the bay for processing by the over the road tractor-trailer. All other equipment is electrically powered and there are no machining or chemical process used that would generate significant amounts of particulate or gases. The single stage of prefilters is appropriate to prolong the life to the HEPA filters.

	Table 5-1 Ventilation System Performance Criteria Facility: RH Surface CVS 411 HV02			IRP assigned Performance Criteria For Evaluation: Safety Significant Hazard Category 2 - Active CVS	
	Evaluation Criteria	Safety Sign. IRP Class	Discussion	Reference	Criteria met by
5	Provide system status instrumentation and/or alarms	Applies	Address key information to ensure system operability (e.g., system delta-P, filter pressure drop)	ASME AG-1, DOE-HDBK-1169, ASHRAE Design Guide (Section 4)	The HEPA filter housings are fitted with pressure monitoring capability for each HEPA filter bank with both local and remote readout. Remote alarms indicate a pressure drop that exceeds set point (alarm function is provided in the Central Monitoring Room (CMR)). WPP has implemented a very conservative pressure drop limit of 5 inches w.g. for HEPA filter dp. Additional instrumentation provides local and remote indication of air flow with remote alarm in the CMR.
6	Interlock supply and exhaust fans to prevent positive pressure differential	Applies		DOE-HDBK-1169, ASHRAE Design Guide (Section 4)	Automated controls provide for interlock between the Supply Air units and the associated Exhaust Air Fans. On the loss of an exhaust fan, the associated supply air fan is shut down. Redundant exhaust air fan and supply air unit is automatically started when the lead ventilation set is "shut-down".
7	Post accident indication of filter break-through	Applies	Instrumentation supports post-accident planning and response	TECH-34	Local and remote indication of HEPA filter differential pressures and proof of air flow provide indication of filter status for post-accident planning and response.
8	Reliability of control system to maintain confinement function under normal, abnormal and accident conditions	Applies	Address, for example, impacts of potential common mode failures from events that would require active confinement function.	DOE-HDBK-1169 (2.4), ASHRAE Design Guide	The confinement ventilation system is comprised of two completely separate "trains" of equipment providing supply air flow, exhaust air flow and confinement filtration (supply fan, exhaust fan and HEPA filter unit). Each "train" is controlled through independent controls and instrumentation. Automated controls can be manually overridden at the local control panel. Common equipment such as space supply flow control and space pressure control via variable exhaust are designed to fail safe providing active confinement ventilation.
9	Control components should fail safe	Applies		DOE-HDBK-1169 (2.4)	Automated controls are designed to fail safe. Pressure Differential Dampers fail open. Local supply flow controls fail in the last controlled position. Exhaust system failure stops associated supply air. Failure of one "train" causes the automatic start of the back-up "train". Train controls can be manually overridden.
10	Confinement ventilation systems should withstand credible fire events and be available to operate and maintain confinement	Applies	As required by the accident analysis for existing facilities, must address protection of fiber media	DOE-HDBK-1169 (10.1), DOE-STD-1066	The DSA does not credit the HEPA filtration in the prevention of the release of hazardous materials. Fire propagation from a source to the filters is not a credible scenario based on the non combustible materials of construction of the building, the non-combustible materials of construction of the CVS components and the amount of combustibles present in the building (building loading of combustibles protected by the administratively controlled combustible loading program).
11	Confinement ventilation systems should not propagate the spread of fire	Applies	As required by the accident analysis for existing facilities, Address fire barriers, fire damper arrangements	DOE-HDBK-1169 (10.1), DOE-STD-1066	The building zones, the construction of the building and the site processes are such that fire dampers and fire suppression within the HEPA filter units is not required. Fans ducts and dampers are constructed of galvanized steel which is adequate based on the constituents that can reasonably be expected to exist in the air stream. Filters and filter housing are constructed of materials such as to not propagate the spread of a fire.
12	Confinement ventilation systems should safely withstand earthquakes	Applies	If the active CVS is not credited in a seismic accident condition, there is no need to evaluate that performance and/or design attribute for the CVS. Any seismic impact on the CVS will be based on the current functional requirements in the DSA	ASME AG-1 AA, DOE O420.1B, DOE-HDBK-1169 (9.2)	The elements of the CVS credited during a seismic event are the seismic/tornado dampers. These dampers are designed and installed in a manner to protect ventilation penetrations of the building envelope during a seismic event (close on seismic event). The closing of the dampers provides for the maintenance of the secondary confinement boundary provided by the building envelope during a seismic event.

	Table 5-1 Ventilation System Performance Criteria Facility: RH Surface CVS 411 HV02			IRP assigned Performance Criteria For Evaluation: Safety Significant Hazard Category 2 - Active CVS	
	Evaluation Criteria	Safety Sign. IRP Class	Discussion	Reference	Criteria met by
13	Confinement ventilation system should safely withstand tornado depressurization	Applies	If the active CVS is not credited in a tornado condition, there is no need to evaluate that performance and/or design attribute for the CVS. Any tornado impact on the CVS will be based on the current functional requirements in the DSA	DOE O420.1B, DOE-HDBK-1169 (9.2)	The elements of the CVS credited during a tornado event are the seismic/tornado dampers. These dampers are designed and installed in a manner to protect ventilation penetrations of the building envelope during a tornado event (close on event). The closing of the dampers provides for the prevention of the rapid depressurization, caused by a tornado, from damaging the confinement barrier provided by the HEPA filters. Rapid depressurization of the exhaust system could cause the filters to be "sucked" through the housing if not properly protected. The tornado dampers are designed to provide that protection.
14	Confinement ventilation system should safely withstand design wind effects on system performance	Applies	If the CVS is not credited in a wind condition, there is no need to evaluate that performance and/or design attribute for the CVS. Any wind impact on the CVS performance will be based on the current NP analysis in the DSA	DOE O420.1B, DOE-HDBK-1169 (9.2)	The DSA does not credit the confinement ventilation system in the event of high winds. The CVS exhaust and filtration systems are housed within the Waste Handling Building and therefore protected from the effects of reasonably assumed high wind events.
15	Confinement ventilation system should withstand other NP events considered credible in the DSA where the CVS is credited	Applies	If the CVS is not credited for this event, there is no need to evaluate that performance and/or design attribute for the CVS. Any impact on the CVS performance will be based on the current NP analysis in the DSA	DOE O420.1B, DOE-HDBK-1169 (9.2)	There are no other natural phenomenon events identified in the DSA which credit the CVS to prevent the release of hazardous materials.
16	Administrative controls should be established to protect confinement ventilation systems from barrier threatening events	Applies	Ensure appropriately thought out response to external threat is defined (e.g., pre-fire plan)	DOE O420.1B	The DSA describes measures that are implemented to protect the facility and structures from credible barrier threatening events at the facility level. The CVS systems are not specifically identified, however the administrative controls that are instituted to protect the facility provide CVS protection.
17	Design supports the periodic inspection and testing of filters and housing, and tests and inspections are conducted periodically	Applies	Ability to test for leakage per intent of N510	DOE-HDBK-1169 (2.3.8), ASME AG-1, ASME N510	WIPP utilizes a computerized history and maintenance planning system (CHAMPS) to track the performance and periodicity of confinement ventilation inspections and testing. System walk-downs are performed annually and aerosol penetration tests (in accordance with the intent of N510) are conducted on an annual basis per CHAMPS generated work orders.
18	Instrumentation required to support system operability is calibrated	Applies	Credited instrumentation should have specified calibration/surveillance requirements. Non-safety instrumentation should be calibrated as necessary to support system functionality.	DOE-HDBK-1169 (2.3.8)	No CVS instrumentation is credited in the DSA in the prevention of the release of hazardous materials in any accident scenario. WIPP utilizes the CHAMPS system and periodic maintenance work orders to generate and track the periodic calibration of instrumentation required to support the CVS operability.
19	Integrated system performance testing is specified and performed	Applies	required responses assumed in the accident analysis must be periodically confirmed including any time constraints	DOE-HDBK-1169 (2.3.8)	There are no CVS required responses in any DSA analyzed accident scenario.

	Table 5-1 Ventilation System Performance Criteria **Facility: RH Surface CVS 411 HV02**			IRP assigned Performance Criteria For Evaluation: Safety Significant Hazard Category 2 - Active CVS	
	Evaluation Criteria	Safety Sign. IRP Class	Discussion	Reference	Criteria met by
20	Filter service life program should be established	Applies	Filter life (shelf life, service life, total life) expectancy should be determined. Consider filter environment, maximum delta-P, radiological loading, age, and potential chemical exposure.	DOE-STD-1169 (3.1 and Appendix C)	WIPP has instituted a filter service life program. Filters are being changed out to assure filters are no more than 10 years old. There is no significant source for potential chemical exposure, radiological exposure or other damaging environmental impacts to the filter media, housings or seals. WIPP has set a differential pressure limit of 5 inches water gauge across the filters. Filters are changed on age or filter pressure drop (which ever occurs first). Because the process and environment is so clean, WIPP has historically changed filters on age long before pressure drop became an issue.
21	Failure of one component (equipment or control) shall not affect continuous operation	Does Not Apply	Address potential failures (example failures- fan, back-up power supply, switchgear)	DOE O420.1B, Facility Safety, Chapter I, Sec. 3.b(8)	Although not applicable, continuous operation is supported through redundant equipment and fail safe configuration of common mode equipment. There is no single point failure in the CVS that will preclude continuous operation.
22	Automatic backup electrical power shall be provided to all critical instruments and equipment required to operate and monitor the CVS	Does Not Apply		DOE-HDBK-1169 (2.2.7)	*Not applicable - see below*
23	Backup electrical power shall be provided to all critical instruments and equipment required to operate and monitor the confinement ventilation system	Applies		DOE-HDBK-1169 (2.2.7)	The confinement ventilation system is powered through switch gear such that on a loss of availability of commercial power, the CVS, system critical instrumentation and associated monitoring equipment can be powered from the site diesel generators.
24	Address any specific functional requirements for the CVS (beyond the scope of those above) credited in the DSA	Applies		10 CFR 830, Subpart B	There are no additional CVS requirements credited by the DSA that have not been previously covered.

DOE Waste Isolation Pilot Plant

Remote Handled Underground Confinement Ventilation System VU01

Ventilation System Evaluation

Revision 0, October 25, 2007

Review and Approval Page

Site Lead:

Richard Farrell	___Signature on File_____	Date: ___________

Evaluation Team Members:

Curtis A. Chester	___Signature on File_____	Date: ___________
Randy D. Elmore	___Signature on File_____	Date: ___________
John J. Garcia	___Signature on File_____	Date: ___________

DOE Field Office Manager:

Dave Moody	___Signature on File_____	Date: ___________

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Definitions

Safety Class.

Safety Class (SC) systems structures and components (SSCs) are those whose preventive or mitigative function is necessary to keep radiological material exposure to the public below the off-site evaluation guideline, which is 25 rem (roentgen equivalent man) total effective dose equivalent. The dose estimates to be compared to it are those received by a hypothetical maximally exposed off-site individual at the site boundary.

Safety Significant.

SSCs not designated as SC, but whose preventive or mitigative function is a major contributor to defense in depth (DiD) and/or worker safety as determined from hazards analysis. Safety Significant (SS) SSC designations based on worker safety are limited to those whose failure is estimated to result in a prompt worker fatality or serious injuries or significant radiological or chemical exposure to workers.

Waste Isolation Pilot Plant (WIPP) procedure WP 09-CN3023, *WIPP Functional Classification for Design*, Rev. 7 identifies greater than 100 rem to the worker as the consequence for requiring consideration for functionally classifying an SSC as SS.

Abbreviations and Acronyms

ALARA – As Low As Reasonably Achievable

CH – Contact Handled

CMR – Central Monitoring Room

CMS – Central Monitoring System

CVS – Confinement Ventilation System

DBE – Design Basis Earth Quake

DBT – Design Basis Tornado

DiD – Defense in Depth

DSA – Documented Safety Analysis

EG – Evaluation Guideline (25 rem TEDE to the maximally-exposed offsite individual as defined in DOE-STD-3009-94)

FET – Facility Evaluation Team as defined in the VSEG

HEPA – High Efficiency Particulate Air

IRP – Independent Review Panel as defined in the VSEG

PDD – Pressure Differential Damper

PISA – Potentially Inadequate Safety Analysis

RH – Remote Handled

SC – Safety Class

SET – Site Evaluation Team as defined in the VSEG

SS – Safety Significant

SSCs – Systems, Structures and Components

TEDE – Total Effective Dose Equivalent

UG – Underground

VSEG – Department of Energy, Deliverables 8.5.4 and 8.7 of Implementation Plan for Defense Nuclear Facilities Safety Board Recommendation 2004-2, *Ventilation System Evaluation Guidance for Safety-Related and Non-Safety-Related Systems*

WAC – Waste Acceptance Criteria

WIPP – Waste Isolation Pilot Plant

Executive Summary:

The Waste Isolation Pilot Plant (WIPP) site is a low level repository for radioactive waste. Waste is characterized and shipped to WIPP in packages for disposal in the repository. The container that the waste is packaged in prior to loading into transportation containers (road casks) provides primary containment. There is no planned normal operation at WIPP that allow for waste to be present external to the waste package container primary containment. The waste container packages that are used for disposal are removed from the transportation containers (road casks) in the Waste Handling Building (WHB). From the time the packages are removed until they are placed in the repository, the packages are contained within facilities and structures with active confinement ventilation systems.

The facility evaluation team (FET) used the independent review panel (IRP) directed functional classification criteria for SS. Based on the evaluation criteria, the system evaluation did not reveal any "gaps" in the installed system's functional design or performance expectations. The installed system's functional design and performance expectations is commensurate with the identified site mission of receiving prepackaged and characterized waste and emplacing the waste in the waste container packages in which the waste is received on site. During the evaluation of the systems functional design and performance expectations against the evaluation criteria and the facility Documented Safety Analysis (DSA), there was no discovery of a potentially inadequate safety analysis (PISA).

Introduction

Facility Overview

The WIPP is located in Eddy County in southeastern New Mexico. The WIPP is located in an area of low population density with no industrial, commercial, institutional, recreational or residential structures within the WIPP Site Boundary.

The WIPP is designed to receive and handle 500,000 cubic feet per year (ft^3/yr) (14,160 cubic meters per year [m^3/yr]) contact handled (CH) waste and 10,000 ft3/yr (283 m^3/yr) remote handled (RH) waste. The WIPP facility is designed to have a disposal capacity for TRU waste of 6.2 million ft^3 (175,600 m^3). The WIPP facility has sufficient capacity to handle the 250,000 ft^3 (7,080 m^3) of RH waste. The WIPP is divided into surface structures, shafts, and subsurface structures.

The WIPP surface structures accommodate the personnel, equipment, and support services required for the receipt, preparation, and transfer of waste from the surface to the underground (UG). Vertical shafts, including the waste shaft, the salt handling shaft, the exhaust shaft, and the air intake shaft, extend from the surface to the UG horizon. The waste shaft is located between the CH and RH areas in the WHB.

The WIPP UG consists of the waste disposal area, construction area, north area, and the waste shaft station area. The CH and RH waste disposal area is a 100 acre area on a horizon located 2,150 feet beneath the surface in a deep, bedded salt formation.

RH waste is shipped to the site in one of two types of road casks. Waste canisters are shipped in 72-B casks. Drums of waste are shipped in 10-160B casks. Waste canisters shipped in 72-B casks are nominally 10 feet long and 26 inches in diameter. Drums of waste received in 10-160B casks, are over-packed into a steel facility canisters in the Hot Cell. Facility canisters are nominally 10 feet long and 28 inches in diameter. Canisters of RH waste are emplaced in the bore holes drilled in the walls of the disposal rooms.

The hazard classification category was determined in accordance with DOE-STD-1027-92. The material at risk for the determination of the categorization was defined as the maximum radiological contents of a single 55-gallon drum of CH waste at 80 plutonium-239 equivalent curies (PE-Ci). Since this inventory exceeds the Hazard Category 2 minimum threshold of 56 Ci for Pu-239, the WIPP is categorized as a Hazard Category 2 facility.

Confinement Ventilation Strategy

The UG ventilation system serves the WIPP underground to provide acceptable working conditions and a life-sustaining environment during normal operations and off normal events including waste handling accidents. All equipment and components of the RH UG CVS are located on the surface and provide ventilation to the UG through the mine exhaust shaft. In the event of a breach of waste containers, the underground ventilation system provides air flow away from the worker. Upon the detection of air borne radioactivity or the notification of a radiation control event, the ventilation system is either automatically or can be manually switched to provide high efficiency particulate air (HEPA) filtration of the mine exhaust.

The UG ventilation system is designed as an exhausting system that maintains the working environment below atmospheric pressure. The UG mine ventilation is designed to supply sufficient quantities of air to all areas of the repository. UG ventilation is divided into four separate flow paths supporting the waste disposal area, the construction area, north area, and the waste shaft station. All four air circuits combine near the exhaust shaft, which acts as the common discharge from the UG. A pressure differential is maintained between the construction circuit and the waste disposal circuit to ensure that any leakage is towards the disposal circuit. The pressure differential is produced by the surface exhaust fans in conjunction with the UG air regulators. Pressure differentials across selected bulkheads between ventilation circuits are monitored from the central monitoring room (CMR).

The UG ventilation system consists of six centrifugal exhaust fans (three main fans in the normal flow path and three smaller fans in the filtration flow path), two identical HEPA filter assemblies arranged in parallel, isolation and back draft dampers, a filter bypass arrangement, and associated ductwork. The main fans are used during normal operation to provide a nominal underground flow. During filtration operations only one filtration fan is in service and all other main and filtration fans are stopped and isolated. Any one of the three filtration fans is capable of delivering 100 percent of the design flow rate with the HEPA filters at their maximum pressure drop. The UG ventilation system is operated as follows:

- Normal Mode - During normal operation, five different levels of ventilation can be established to provide five different air flow quantities.
- Filtration Mode - This mode mitigates the consequences of a waste handling accident releasing radioactive contamination to the environment by providing a HEPA filtered air exhaust path from the underground and also reducing the air flow.

Filtration is activated automatically on a high radiation signal from one of the continuous air monitors in the exhaust of the active disposal room, or manually by the CMR operator, through the central monitoring system (CMS), when notified of a waste handling event underground. The operating status of the exhaust fans are displayed in the CMR and provisions to switch to filtration are provided. An alarm for excessive pressure drop across the filters is actuated at a predetermined level. Filter differential pressure is displayed locally and in the CMR. Instruments and system components are accessible for periodic testing and inspection during normal plant operation.

Under normal operating conditions, the ventilation system functions continuously. The underground ventilation system filtration fans can be connected to the backup power supply, one at a time, in the event that normal power is lost. Air is routed through the individual disposal rooms within a panel using UG bulkheads and air regulators.

Each HEPA filter assembly that serves the UG is equipped with two banks of prefilters and two banks of HEPA filters. All nuclear grade HEPA filter banks are tested for conformance with ASME N510.

The system was installed in stages starting in the mid 1980s. Originally the smaller exhaust filtration fans were installed. Two of the larger main fans were installed in the early 1990s with the third main fan installed in 1996 – 1997. The original design information is maintained and available at the WIPP.

Major Modifications

The facility is not currently undergoing any major modifications that affect the ventilation system or its operation.

Functional Classification Assessment

The WIPP procedure WP 09-CN3023, WIPP Functional Classification for Design, is the site procedure used for functional classification.

Existing Classification

Based on site procedures the RH UG CVS of this evaluation is classified as a safety significant system. This CVS is credited in the site DSA for preventing prompt, significant radiological or chemical exposure to workers.

Evaluation

The FET used the proceduralized site process, WP 09-CN3023, to evaluate the existing site functional classification of the CVS evaluated. Additionally, the FET reviewed the site procedure for compliance with DOE regulations and drivers to assess that the site procedure provides adequate assessment of functional classification for site systems.

The RH UG CVS was found to have the proper existing functional classification per WP 09-CN3023.

The procedure, WP 09-CN3023, was found to be inline with the DOE-STD-3009-94 guidance for functional classification. The FET did discover one typographical error in the procedure. The typographical error is being corrected.

Summary

The existing facility RH UG CVS functional classification is appropriate. The system provides ventilation that provides ventilation required for industrial safety issues and directs airflow away from the workers in various DSA analyzed accident scenarios.

System Evaluation

Identification of Gaps

The FET identified there were no gaps between the *Ventilation System Evaluation Guidance for Safety-Related and Non-Safety-Related Systems* VSEG evaluation criteria and the installed system's functional design or performance expectations.

The FET used the IRP directed SS performance criteria for the evaluation in accordance with the guidance in section 5.1 of the VSEG. Section 5.1 identifies that all hazard category 2 nuclear facilities that do not challenge or exceed the evaluation guideline (EG) will utilize SS performance criteria as identified in Table 5-1 of the VSEG.

The evaluation verified all the VSEG established performance criteria for SS CVS systems were adequately met by the CVS. The criteria established to be mandatory for this evaluation were:

a. Materials of Construction should be appropriate for normal, abnormal and accident conditions.
b. Confinement ventilation systems shall have appropriate filtration to minimize release.
c. Provide system status instrumentation and/or alarms.
d. Post accident indication of filter break-through.
e. Reliability of control system to maintain confinement function under normal, abnormal and accident conditions.
f. Control components should fail safe.
g. Administrative controls should be in place to protect confinement ventilation systems from barrier threatening events.
h. Design supports periodic inspection and testing of filters and housing, and tests and inspections are conducted periodically.
i. Filter service life program should be established.
j. Failure of one component (equipment or control) shall not affect continuous operation.
k. Backup electrical power shall be provided to all critical instruments and equipment to operate and monitor the CVS.

The above listed criteria are required for the system to adequately provide the DSA credited safety significant system function.

All other IRP established VSEG performance criteria, identified in Table 5-1 of the VSEG, were determined to not be mandatory. The non-mandatory criteria were identified within the VSEG to be "applicable as required" or "credited by the facility DSA". The facility DSA does not credit the RH UG CVS to prevent or control hazardous release in the accident analyses.

Gap Evaluation

The FET identified there were no gaps between the VSEG evaluation criteria and the installed system's functional design or performance expectations, whether mandatory or non-mandatory.

Modifications and Upgrades

There are no required modifications or upgrade to the RH UG CVS since there are no gaps between the established performance criteria and the installed system's functional design or performance expectations.

Conclusion

The FET performed an evaluation of the RH UG CVS. The result of the evaluation was a determination that the system's installed design and performance expectations met the evaluation performance criteria established by the VSEG IRP for a Hazard Category 2 facility. There were no findings or proposed corrective actions as a result of this evaluation.

While there are no modifications or upgrades required, the system equipment is subject to a corrosive environment. There are corrosion and salt accumulations issues that will require attention for the life of the facility. These issues are being managed and continue to be managed through proper maintenance and equipment refurbishment.

References

ASME N510 — American Society of Mechanical Engineers, 1989, *Standard for Testing of Nuclear Air Cleaning Systems*, (formerly ANSI N510-1975, ANSI/ASME N510-1989)

CH DSA — DOE/WIPP-95-2065, REVISION 10, NOVEMBER 2006, Waste Isolation Pilot Plant Contact Handled (CH) Waste Documented Safety Analysis, with approved page changes CH-2007-01 and CH-2007-02, August 27, 2007

DOE-STD-3009-94 — DOE Standard Preparation Guide for U.S Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses, with Change Notice No. 2, April 2002

DOE-STD-1027-92 — DOE Standard, Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23,

Nuclear Safety Analysis Reports, with Change Notice No. 1, September 1997

DOE HDBK-1169-2003 DOE Handbook, Nuclear Air Cleaning Handbook

RH DSA DOE/WIPP-06-3174, REVISION 0, MARCH 2006, Waste Isolation Pilot Plant Remote Handled (RH) Waste Documented Safety Analysis, with page changes approved through August 28, 2007

SDD VU00 U.S. Department of Energy, Waste Isolation Pilot Plant, Underground Ventilation System Design Description, Rev. 12

WP 09-CN3023 *WIPP Functional Classification for Design*, Rev. 7

Attachments

Facility Evaluation Team composition and biographical sketches

Attachment 1 – FET members' Personnel Profiles

Data Collection Table and supporting attachments

Attachment 2 – Data Collection Table

Table 4-3

Attachment 3 - Supporting Attachments

RH Underground CVS VU01, Table 5-1 Ventilation System Performance Criteria and Evaluation Response

Summary Schedules for implementing upgrades

Not applicable – no identified "gaps" or required upgrades

Completed supporting evaluations and documentation

Not applicable.

Attachment 1

Field Evaluation Team Personal Profiles | Page

Attachment 1

Personal Profile: **Richard F. Farrell**
Position: **Nuclear Safety Specialist**
U. S. DOE Carlsbad Field Office
(505) 234-8318

Summary:

1. Environmental, Safety, and Health (E,S&H) professional with over 30 years of diversified experience in nuclear and industrial safety, health physics, environmental/effluent monitoring, regulatory compliance related to state-of-the-art nuclear facilities, and mining and mineral extraction/ metallurgical processing.
2. Managed the development of the Waste Isolation Pilot Plant (WIPP) documented safety analysis (DSA) for contact-handled and remote-handled transuranic (CH/RH-TRU) waste disposal operations. Developed and the Department of Energy's (DOE) safety evaluation reports (SER) or approval bases associated with the WIPP safety basis.
3. Developed and managed the Radioactive Source Materials License compliance programs for a NRC licensed facility (an operating uranium mill/mine) including: radiological and industrial safety, ALARA, quality assurance, occupational health, and underground mine ventilation engineering and monitoring.

Experience:

U. S. Department of Energy; September 2007 - Present
Nuclear Safety Specialist Carlsbad Field Office (CBFO) Responsibilities include oversight and integration of CBFO/WIPP radiological and nuclear safety, occupational health, and nuclear safety management.
Safety Officer CBFO; August 2000 – September 2007 Responsibilities include oversight and integration of CBFO/WIPP industrial, radiological and nuclear safety, and occupational health.

U. S. Department of Energy; September 1992 - August 2000
Radiological Safety Manager Carlsbad Area Office (CAO) Responsibilities include oversight and management of CAO/WIPP radiological safety/control programs (10 CFR Part 835) and nuclear safety management (10 CFR Part 830).

Westinghouse Electric Corporation; April 1990 - September 1992
Senior Engineer at the Waste Isolation Pilot Plant Responsibilities include the management of interface activities with oversight and auditing groups, evaluation of applicable regulations and DOE orders, and support of audits of waste generator sites with regard to waste acceptance criteria.

Homestake Mining Company; 1977 - April 1990
(Nuclear Regulatory Licensed Uranium Milling and Mining)
Environmental Safety and Health Department On-Site Manage; 1983 - April 1990
Responsible for radiation safety/health programs as the radiation safety officer (RSO) for the Nuclear Regulatory Commission (NRC) licensed facility. Responsibilities included department administration, industrial safety/health, emergency management, RCRA compliance and hazardous waste management, CERCLA remediation and monitoring activities, occupational health and regulatory compliance.

Attachment 1

Radiation Protection Administrator; 1980 - 1983 Responsibilities included management of the health physics, oand hazardous waste activities, training, environmental and effluent monitoring, and regulatory compliance. Served as the RSO for a NRC licensed facility.
Radiological Safety/Environmental Engineer; 1977 - 1980 Responsibilities included evaluation of radiological safety, health physics assessment, monitoring data, and the development of monitoring and emission control programs to assure compliance with occupational and environmental regulations.

Education:

B.S. - Chemistry major - biology minor, Northern Arizona University, 1975.
Twelve (12) semester hours of graduate level chemistry class work, and six (6) semester hours of graduate level radioactive waste management; University of New Mexico; 1981 and 1992, respectively.
Strong background in applied mathematics and statistics equivalent to a minor area of study [twenty (20) semester hours], Brigham Young University; 1993 - 1996.

Attachment 1

Personal Profile: **Curtis A. Chester**
Position: **Engineering Manager**
Integrated Waste Handling Engineering
Washington TRU Solutions LLC
WIPP Site

Summary:

Mr. Chester is the Washington TRU Solutions manager of the Integrated Waste Handling Engineering (IWHE) group. IWHE is responsible for the technical ownership of all equipment used in the waste handling process, both Contact Handled and Remote Handled. Mr. Chester's staff consists of 17 engineers engaged in oversight of systems that include such diverse applications of engineering as robotics in waste processing, radiological monitoring systems, pumping and distributions systems for fire suppression, industrial material handling systems, facility structural integrity (including seismic and tornado loading) and confinement ventilation. The IWHE group is tasked with monitoring, maintaining, designing and planning the implementation of regulatory requirements associated with aspects of safety, environmental and radiological requirements for the site waste handling process. As manager of the IWHE group, Mr. Chester is responsible for administration of the proper oversight, review and approval of the actions implemented by the group.

Mr. Chester has participated in two successful Operational Readiness Reviews while at WIPP and was the lead engineer in the successful completion of the Remote Handled readiness review completed in January of 2007 including the system Start-up Testing and the system Line Management Assessment. Mr. Chester's experience and accomplishments in mechanical design, shop fabrication, procurement, engineering application of quality control and application of industrial process control make him uniquely suited for management of the IWHE group.

Professional History:

Manager / Integrated Waste Handling Engineering (1998 to present)
WGI/ Washington TRU solutions Carlsbad, New Mexico
Management of personnel employed in the development and implementation of strategies, resource allocations, baselines, and project execution plans for package handling equipment, system upgrades, and processes supporting the disposal of Defense Nuclear Waste. Successes and competence have been identified with a continuous progression of assignments from support engineer to engineering staff management.

Project Engineer / Staff Consultant (1993 to 1997)
Duke Engineering & Services Carlsbad, New Mexico
Provide design, analysis, and project management services to engineering and maintenance staff at the Waste Isolation Pilot Plant (WIPP).

Product Integrity Engineer/ Lead Manufacturing Engineer (1990 to 1993)
Martin Marietta Corporation Albuquerque, New Mexico
Develop and maintain process flow instructions and configuration management for multiple process lines. Conduct engineering analysis on mechanical structures and assemblies. Develop and implement quality, cost effective manufacturing practices regarding station layouts, sequence of operations, and tooling requirements.

Staff Engineer (1989-1990, 1993)

Attachment 1

Pharmacia SP Albuquerque, New Mexico
Perform engineering analysis on equipment. Develop equipment enhancements. Design and prototype special devices.

Education:

B.S. in Mechanical Engineering, **UNM Albuquerque, NM,** 1989

Publications:

"Final Results of the WIPP RH TRU Facility Shielding Analysis". 2002
"Exhaust Shaft Hydraulic Assessment Data Report". 1996
"Room Q Data Report: Test Borehole Data From December 7, 1993, through July 7, 1995". 1995

Attachment 1

Personal Profile: **Randy D. Elmore**
Position: **Cognizant System Engineer**
Confinement Ventilation Systems
Washington TRU Solutions LLC
WIPP Site

Summary:

Mr. Elmore is an engineer with over twenty years of experience with HVAC systems used for environmental, commercial and industrial applications including medical isolation suites, industrial clean room and laboratory and confinement ventilation systems. Experience includes the design, installation, start-up and oversight of isolation environments established through both positive and negative pressure differentials. Design activities have included not only air and equipment side but pneumatic, electronic and microprocessor design, programming, and start-up. Ancillary experiences and skills include cost estimation, project management, budgeting and system and personnel management.

Professional History:

Washington TRU Solutions, LLC. Carlsbad, New Mexico, 2001 – present:

Simplex Time Recorder, Inc., Lubbock, Texas, West Texas Marketing and Management Representative, 1998 to 2000

CSG (Compliance Services Group), Lubbock, Texas, Project Manager, 1996 to 1998

Con-Tech (Control Technologies), Lubbock, Texas, Co-Founder and Principal, 1992 to 1996

David G. Halley & Co., Inc., Lubbock, Texas, Sales Engineer / Stockholder, 1986 to 1992

Texas Instruments, Abilene, Texas, Project Engineer, 1985 to 1986

Williams, Tippet, and Associates, Inc., Abilene, Texas, Design Engineer, 1984 to 1985

Shell Pipeline Corp., Hamlin, Texas, Roustabout / Relief Technician, 1980 to 1982

Education:

B.S. in Mechanical Engineering, **Texas Tech University,** 1984 (Magna Cum Laude)

Professional Organizations:

Academy of Mechanical Engineers, Texas Tech University (Faculty Advisory Council, inducted April 2004)

Attachment 1

Personal Profile: **John J. Garcia**
Position: **Senior Manager**
Deputy Engineering Manager
Washington TRU Solutions LLC
WIPP Site

Summary

Proven executive level manager experienced in strategic planning, Program Management, Operations and Engineering management and business/product development of state-of-the-art nuclear facilities. Twenty-five plus years of progressive management experience. Proven ability to build new organizations, reorganize troubled organizations and expand into additional markets. Innovative problem solver and effective communicator adept in delivering superior customer service and developing new business.

Professional Experience:

Washington TRU Solutions, LLC, Carlsbad, NM – 6/1988 to Present

Deputy Engineering Manager (01/05 to Present)

- Management responsibility for implementation/improvement/maintenance of the site engineering and Nuclear Safety Programs.

Safety, Health, Security and Technical Support (02/03 to 01/05)

- Responsible for establishing and maintaining facility safety and health programs. Accomplished over 2 million work hours without a lost workday.
- Responsible for approximately 60 + employees and budget of 10 million.

Deputy Assistant General Manager Operations and Chief Engineer (02/01 to 02/03)

- Responsible for all site engineering issues listed under Engineering Manager
- Deputy Assistant General Manager Operations responsible for 400+ employees and budget of $80 Million.

Engineering Manager (Westinghouse Waste Isolation Division – 1995 to 2001)

- Responsible for 100+ employees and annual budget of $22 million.
- Assisted General Manager in establishing strategic direction and policy for the division.

- Managed an integrated, multi-disciplined infrastructure including business systems, multi-disciplined engineering functions, facility construction and configuration management processes.
- Maintained Nuclear Regulatory Commission package compliance and maintenance, generator site interface, transportation planning and tracking, Waste Acceptance Criteria requirements generation, and designed and maintained the WIPP Waste Information System for the National TRU (Transuranic Waste) Program.

Successive Engineering Management Positions including Manager, Program Management (1988-1995)

- Responsible for 35+ employees and budgets in excess of $12 million in preparation for start-up of the facility.
- Managed the division's budgeting and scheduling work scope.
- Integrated program details to establish current year budgets and five year planning.
- Tracked division performance and provided division support for program planning of major DOE or division initiatives.

Westinghouse Hanford Company, Hanford, WA – 1972 to1988

Engineering Positions of increasing responsibility leading to Manager, Waste Package, Repository and Seals Analysis Section

- Directed activities of 18 engineers and scientists and a budget of $4.5 million.
- Oversaw performance of critical engineering analyses and development of computer code to support design verification for the section.
- Designed software analytical packages for evaluating geotechnical, mechanical, hydrological, and thermal performance of the facility.

Education

B. S. - Mechanical Engineering, University of Texas, El Paso

Additional Master's Level Engineering courses

National Institute for Learning: "The Project Management Certificate Course"

Fluent in English and Spanish

Confinement Ventilation Documented Safety Analysis Information										
Facility: RH U/G VU01			Hazard Category 2					Performance Expectation		
Bounding Accidents	Type Confinement: Active	Type Confinement: Passive	Doses Bounding unmitigated / mitigated	Confinement Ventilation System Classification: SC	Confinement Ventilation System Classification: SS	Confinement Ventilation System Classification: DID	Function	Functional Requirements	Performance Requirements	Compensatory Measures
(1-Fire) N/A	X		> 25 rem / prevented		X		In-facility worker protection	Required to provide sufficient airflow to direct airflow away from workers during waste handling in the event of a waste container breach. Sufficient airflow must also be maintained to facilitate evacuation of underground workers in the event of underground fires. The underground ventilation system is required to provide at least 20,000 scfm at the base of the waste shaft and 42,000 scfm in the active disposal room	The TSRs require daily check of the minimum airflow in active disposal room and in the waste shaft ventilation circuit	The performance functional evaluation did not reveal any vulnerability. No compensatory measures required.
(2 -Explosion) N/A	X		> 25 rem / prevented		X		In-facility worker protection	Required to provide sufficient airflow to direct airflow away from workers during waste handling in the event of a waste container breach. Sufficient airflow must also be maintained to facilitate evacuation of underground workers in the event of underground fires. The underground ventilation system is required to provide at least 20,000 scfm at the base of the waste shaft and 42,000 scfm in the active disposal room	The TSRs require daily check of the minimum airflow in active disposal room and in the waste shaft ventilation circuit	The performance functional evaluation did not reveal any vulnerability. No compensatory measures required.
(3 _Loss of Containment / Confinement) N/A	X		> 25 rem / prevented		X		In-facility worker protection	Required to provide sufficient airflow to direct airflow away from workers during waste handling in the event of a waste container breach. Sufficient airflow must also be maintained to facilitate evacuation of underground workers in the event of underground fires. The underground ventilation system is required to provide at least 20,000 scfm at the base of the waste shaft and 42,000 scfm in the active disposal room	The TSRs require daily check of the minimum airflow in active disposal room and in the waste shaft ventilation circuit	The performance functional evaluation did not reveal any vulnerability. No compensatory measures required.
(4 -Direct Radiological / Chemical Exposure)	N/A		N/A				N/A	N/A		None Identified Based on Risk
(5 -Nuclear Criticality)	N/A		N/A				N/A	N/A		Not credible for the WIPP due to WAC requirements/restrictions and established waste handling procedures/processes.
(6 -External Hazards)	N/A		N/A				N/A	N/A		None Identified Based on Risk
(7 -Natural Phenomena)	N/A		N/A				N/A	Required to provide sufficient airflow to direct airflow away from workers during waste handling in the event of a waste container breach. Sufficient airflow must also be maintained to facilitate evacuation of underground workers in the event of underground fires. The underground ventilation system is required to provide at least 20,000 scfm at the base of the waste shaft and 42,000 scfm in the active disposal room		None Identified Based on Risk

The confinement ventilation portion of the underground ventilation system provides a defense in depth function for accidents assoicated with operational and natural phenomenon events that could effect RH waste.

Table 5-1 Ventilation System Performance Criteria IRP assigned Performance Criteria For Evaluation: Safety Significant
Facility: RH U/G CVS VU01 Hazard Category 2 - Active CVS

	Evaluation Criteria	Safety Sign. IRP Class	Discussion	Reference	Criteria met by
1	Pressure Differentials should be maintained between zones and atmosphere	Applies	Number of zones as credited by accident analysis to control hazardous release; demonstrate by use considering potential in-leakage	DOE-HDBK-1169 (2.2.9), ASHRAE Design Guide	Pressure differentials are validated by measured flow rate. Flow rate validated with each change of ventilation control setting. Flow rates are verified no less than once per shift
2	Materials of Construction should be appropriate for normal, abnormal and accident conditions	Applies		DOE-HDBK-1169 (2.2.5), ASME AG-1	The Mine drifts themselves serve as the underground air flow conduits. The 8 gauge surface duct, structural supports and fans are adequately constructed.
3	Exhaust system should withstand anticipated normal, abnormal and accident system conditions and maintain integrity	Applies	As required by accident analysis to prevent accident release	DOE-HDBK-1169 (2.4), ASHRAE Design Guide	WIPP ground control measures assures adequate underground integrity. There is no accident scenario that will impact the system integrity except for natural phenomenon (NP). The only DSA identified accident scenarios that can effect the surface fans and ducts of the CVS are NP and are addressed in the following.
4	Confinement ventilation systems shall have appropriate filtration to minimize release	Applies	Address: 1) Type of filter (e.g., HEPA, sand, sintered metal); 2) Filter Sizing (flow capacity and pressure drop); 3) Decontamination Factor vs. accident analysis assumptions	ASME AG-1, DOE HDBK-1169 (2.2.1)	WIPP underground filtration is provided by two 7 wide by 3 high HEPA filter housing (24"x24" filters). Each housing is rated for 30,000 cfm. The air flow is reduced to 60,000 cfm during filtration. Mine exhaust air flow is not normally directed through the filters. This allows the filters to be kept clean and dry.
5	Provide system status instrumentation and/or alarms	Applies	Address key information to ensure system operability (e.g., system delta-P, filter pressure drop)	ASME AG-1, DOE-HDBK-1169, ASHRAE Design Guide (Section 4)	The HEPA filter housings are fitted with pressure monitoring capability for each HEPA filter bank with both local and remote readout. Remote alarms indicate a pressure drop that exceeds set point (alarm function is provided in the Central Monitoring Room (CMR)). WIPP has implemented a very conservative pressure drop limit of 5 inches w.g. for HEPA filter dp. Additional instrumentation provides local and remote indication of air flow with remote alarm in the CMR.
6	Interlock supply and exhaust fans to prevent positive pressure differential	Applies		DOE-HDBK-1169, ASHRAE Design Guide (Section 4)	The underground ventilation system is a draw through ventilation system without supply fans. Natural ventilation pressure (NVP) can cause very slight ventilation pressures differentials at certain points in the mine. However, NVP is not an issue in the emplacement room or the waste face. The emplacement room and the waste face are the areas of concern from the credited DSA perspective.
7	Post accident indication of filter break-through	Applies	Instrumentation supports post-accident planning and response	TECH-34	Local and remote indication of HEPA filter differential pressures and proof of air flow provide indication of filter status for post-accident planning and response.
8	Reliability of control system to maintain confinement function under normal, abnormal and accident conditions	Applies	Address, for example, impacts of potential common mode failures from events that would require active confinement function.	DOE-HDBK-1169 (2.4), ASHRAE Design Guide	The confinement ventilation system is comprised of three separate exhaust fans for normal (700 fans) and three separate fans for filtration (860 fans) air flow. The 700 and 860 fans can be ran in multiple configurations. Each fan has its own control system. The two filter housings that are employed during filtration events are parallel. Common isolation dampers have manual override capability and dual dampers to provide system redundancy to reduce the risk to site operations due to equipment outages. The extensive equipment redundancy provides for high availability of equipment to support operations thus providing reliable operation in normal, accident and abnormal operations.

Table 5-1 Ventilation System Performance Criteria IRP assigned Performance Criteria For Evaluation: Safety Significant

Facility: RH U/G CVS VU01 Hazard Category 2 - Active CVS

	Evaluation Criteria	Safety Sign. IRP Class	Discussion	Reference	Criteria met by
9	Control components should fail safe	Applies		DOE-HDBK-1169 (2.4)	Isolation dampers are configured to fail safe providing underground containment of any release of materials from the repository should a release occur during the event of equipment failure. The failure of any other CVS control component will not affect the system integrity.
10	Confinement ventilation systems should withstand credible fire events and be available to operate and maintain confinement	Applies	As required by the accident analysis for existing facilities, must address protection of fiber media	DOE-HDBK-1169 (10.1), DOE-STD-1066	There is no accident analysis associated with fire events that would render the filter media ineffective for confinement. The filter media is approximately one-half mile from the repository area where credible fire events could take place. The HEPA filters are housed inside a all metal filter housing in a building of non-combustible construction without significant sources of ignition or fire source material in the immediate vicinity.
11	Confinement ventilation systems should not propagate the spread of fire	Applies	As required by the accident analysis for existing facilities, Address fire barriers, fire damper arrangements	DOE-HDBK-1169 (10.1), DOE-STD-1066	The filters and housing are of non-combustible construction. While the ventilation flow can support the sustaining of a fire in the underground, the air flow is required to support evacuation. The structure of the mine (chloride salt and clay) is non-combustible and the greatest hazard to the workers in a fire event is smoke. Ventilation flow and evacuation procedures for the mine are established to minimize the hazard to the workers. Ventilation flow can be controlled from the surface. The Facility Shift Manager (or designee) is responsible for emergency response operations which are established to provide the safest operational configuration in protection of the public, the workers and the environment.
12	Confinement ventilation systems should safely withstand earthquakes	Applies	If the active CVS is not credited in a seismic accident condition, there is no need to evaluate that performance and/or design attribute for the CVS. Any seismic impact on the CVS will be based on the current functional requirements in the DSA	ASME AG-1 AA, DOE O420.1B, DOE-HDBK-1169 (9.2)	The system is not credited in the DSA to prevent the release of industrially or radiologically hazardous materials in the event of an earthquake.
13	Confinement ventilation system should safely withstand tornado depressurization	Applies	If the active CVS is not credited in a tornado condition, there is no need to evaluate that performance and/or design attribute for the CVS. Any tornado impact on the CVS will be based on the current functional requirements in the DSA	DOE O420.1B, DOE-HDBK-1169 (9.2)	The system is not credited in the DSA to prevent the release of industrially or radiologically hazardous materials in the event of a tornado.
14	Confinement ventilation system should safely withstand design wind effects on system performance	Applies	If the CVS is not credited in a wind condition, there is no need to evaluate that performance and/or design attribute for the CVS. Any wind impact on the CVS performance will be based on the current NP analysis in the DSA	DOE O420.1B, DOE-HDBK-1169 (9.2)	The system is not credited in the DSA to prevent the release of industrially or radiologically hazardous materials in the event of a high wind condition.
15	Confinement ventilation system should withstand other NP events considered credible in the DSA where the CVS is credited	Applies	If the CVS is not credited for this event, there is no need to evaluate that performance and/or design attribute for the CVS. Any impact on the CVS performance will be based on the current NP analysis in the DSA	DOE O420.1B, DOE-HDBK-1169 (9.2)	There are no other natural phenomenon events identified in the DSA which credit the CVS to prevent the release of hazardous materials.

	Table 5-1 Ventilation System Performance Criteria **Facility: RH U/G CVS VU01**			IRP assigned Performance Criteria For Evaluation: Safety Significant Hazard Category 2 - Active CVS	
	Evaluation Criteria	Safety Sign. IRP Class	Discussion	Reference	Criteria met by
16	Administrative controls should be established to protect confinement ventilation systems from barrier threatening events	Applies	Ensure appropriately thought out response to external threat is defined (e.g., pre-fire plan)	DOE O420.1B	The DSA describes measures that are implemented to protect the facility and structures from credible barrier threatening events at the facility level. The CVS systems are not specifically identified, however the administrative controls that are instituted to protect the facility provide CVS protection.
17	Design supports the periodic inspection and testing of filters and housing, and tests and inspections are conducted periodically	Applies	Ability to test for leakage per intent of N510	DOE-HDBK-1169 (2.3.8), ASME AG-1, ASME N510	WIPP utilizes a computerized history and maintenance planning system (CHAMPS) to track the performance and periodicity of confinement ventilation inspections and testing. System walk-downs are performed annually and aerosol penetration tests (in accordance with the intent of N510) are conducted on an annual basis per CHAMPS generated work orders.
18	Instrumentation required to support system operability is calibrated	Applies	Credited instrumentation should have specified calibration/surveillance requirements. Non-safety instrumentation should be calibrated as necessary to support system functionality.	DOE-HDBK-1169 (2.3.8)	No CVS instrumentation is credited in the DSA in the prevention of the release of hazardous materials in any accident scenario. WIPP utilizes the CHAMPS system and periodic maintenance work orders to generate and track the periodic calibration of instrumentation required to support the CVS operability. The shift-to-filtration operation of the CVS is checked quarterly.
19	Integrated system performance testing is specified and performed	Applies	required responses assumed in the accident analysis must be periodically confirmed including any time constraints	DOE-HDBK-1169 (2.3.8)	There are no CVS required responses in any DSA analyzed accident scenario. The shift-to-filtration operation of the CVS is checked quarterly.
20	Filter service life program should be established	Applies	Filter life (shelf life, service life, total life) expectancy should be determined. Consider filter environment, maximum delta-P, radiological loading, age, and potential chemical exposure.	DOE-STD-1169 (3.1 and Appendix C)	WIPP has instituted a filter service life program. Filters are being changed out to assure filters are no more than 10 years old. There is no significant source for potential chemical exposure, radiological exposure or other damaging environmental impacts to the filter media, housings or seals. WIPP has set a differential pressure limit of 5 inches water gauge across the filters. Filters are changed on age or filter pressure drop (which ever occurs first). Because the process and environment is so clean, WIPP has historically changed filters on age long before pressure drop became an issue.
21	Failure of one component (equipment or control) shall not affect continuous operation	Does Not Apply	Address potential failures (example failures-fan, back-up power supply, switchgear)	DOE O420.1B, Facility Safety, Chapter I, Sec. 3.b(8)	Although not applicable, equipment redundancy (fans) and manual control operation of both fans and dampers allow for continued operation with any single point failure. The fans used for HEPA filtration can be powered from site generators on a loss of commercially available power.
22	Automatic backup electrical power shall be provided to all critical instruments and equipment required to operate and monitor the CVS	Does Not Apply		DOE-HDBK-1169 (2.2.7)	Not applicable.
23	Backup electrical power shall be provided to all critical instruments and equipment required to operate and monitor the confinement ventilation system	Applies		DOE-HDBK-1169 (2.2.7)	The fans used for HEPA filtration, system critical instrumentation and associated monitoring equipment can be powered from site generators on a loss of commercially available power.

	Table 5-1 Ventilation System Performance Criteria **Facility: RH U/G CVS VU01**			IRP assigned Performance Criteria For Evaluation: Safety Significant Hazard Category 2 - Active CVS	
	Evaluation Criteria	Safety Sign. IRP Class	Discussion	Reference	Criteria met by
24	Address any specific functional requirements for the CVS (beyond the scope of those above) credited in the DSA	Applies		10 CFR 830, Subpart B	There are no additional CVS requirements credited by the DSA that have not been previously covered.

SEPARATION

PAGE

DOE F 1325.8
(4/93)

07.1680

United States Government **Department of Energy**
Oak Ridge Office

memorandum

DATE: October 31, 2007

REPLY TO
ATTN OF: EM-90:McCracken

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

TO: James Owendoff, Chief Operating Officer, Office of the Assistant Secretary for Environmental Management, EM-3, FORS

REF: 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.

This memorandum provides the Confinement Ventilation System Evaluations for the Oak Ridge Office of Environmental Management facilities determined to be low priority in response to the referenced memorandum. Attached are the System Evaluations for the Fission Product Development Laboratory, Building 3517; and for the Molten Salt Reactor Experiment (MSRE) Facility. Three gaps relative to the evaluation criteria were identified by the System Evaluation for the 3517 Building and two gaps were identified for the MSRE facility. Each of these gaps were determined to not be mandatory based on the facilities' 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.

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

Stephen H. McCracken
Assistant Manager for
Environmental Management

Attachments (2)

See cc's on page 2

cc w/ attachments:
Dae Chung, EM-60, FORS
Robert Nelson, EM-60, FORS
Robert Brown, M-2, FOB
Harold Monroe, SE-31, 2714 Complex
Jay Mullis, EM-90, 2714 Complex
Donna Perez, EM-90, 2714 Complex
Andrea Perkins, EM-90, 2714 Complex
Gary Riner, EM-94, 2714 Complex
Annette Bartlett, Safety Basis Team, 2714 Complex
Gary Gault, Safety Basis Team, 2714 Complex
Michael Hughes, BJC, Bldg 1225, MS-7294
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BJC/OR-2897

ACTIVE CONFINEMENT SYSTEM EVALUATION SUMMARY REPORT FOR DNFSB 2004-2

FISSION PRODUCT DEVELOPMENT LABORATORY, BUILDING 3517, OAK RIDGE, TENNESSEE

BJC/OR-2897

ACTIVE CONFINEMENT SYSTEM EVALUATION SUMMARY REPORT FOR DNFSB 2004-2

FISSION PRODUCT DEVELOPMENT LABORATORY, BUILDING 3517, OAK RIDGE, TENNESSEE

Date Issued—[September 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 Confinement System Evaluation Summary Report for DNFSB 2004-2

Fission Product Development Laboratory, Building 3517, Oak Ridge, Tennessee)

[BJC/OR-2897]

September 2007

Prepared by:

_______________________________ 27 September 07
Ross Harding — Date
Nuclear Facility Safety Lead
Bechtel Jacobs Company LLC

_______________________________ 28 Sep' 07
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ACRONYMS

BJC	Bechtel Jacobs Company LLC
CVS	Cell Ventilation System
D&D	Deactivation and Decommissioning
DID	Defense In Depth
DNFSB	Defense Nuclear Facilities Safety Board
DOE	U.S. Department of Energy
DP	differential pressure
DSA	Documented Safety Analysis
FET	Facility Evaluation Team
FPDL	Fission Product Development Laboratory
HEPA	High-efficiency particulate air
LCO	Limiting Condition for Operation
LLLW	Liquid Low-Level Waste
NFPA	National Fire Protection Association
ORNL	Oak Ridge National Laboratory
POG	Process Off Gas
S&M	Surveillance and Maintenance
WG	Water gauge

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1. INTRODUCTION

An evaluation of the Fission Product Development Laboratory (FPDL), Building 3517, and its cell ventilation system and its associated strategy is provided in the following sections.

1.1 FACILITY OVERVIEW

Building 3517 (FPDL) is a partially deactivated nuclear facility that no longer has a programmatic mission and has been transitioned to the Environmental Management Program to be deactivated and decommissioned. The facility is undergoing transitional surveillance and maintenance (S&M) and limited deactivation activities until assets are available for final decommissioning. Although all process-related activities have been discontinued in Building 3517, the facility still contains radioactive and hazardous materials.

Surveillance and maintenance includes activities such as performing facility walk-downs to detect changing conditions, monitoring the ventilation systems to verify that they are operating within specified parameters, etc. High-efficiency particulate air (HEPA) and roughing filters are replaced as required. Radiological surveys are conducted to confirm that migration of radioactive contamination is not occurring. Radiological monitoring equipment, pressure gauges, liquid level detectors, and other instrumentation are periodically calibrated. The building sprinkler system is periodically tested and flushed. The levels in the liquid low-level tanks in the tank farm cells are monitored and emptied as necessary. The contents of the tanks are discharged to the liquid low-level waste (LLLW) headers by steam jets.

1.2 FACILITY STRUCTURE

Building 3517 is a two-story, steel and concrete block structure containing operating areas, service areas, offices, and personnel access areas. A cooling tower supporting the air conditioning and chilled water systems lies northeast of the building. A third-story, aluminum-sided superstructure encloses a 20-ton crane, which services the operating cells. The exterior walls of the first two floors are constructed of 12-inch concrete blocks. The exterior walls of the airlocks consist of insulated metal siding. The interior walls are either concrete block or gypsum board construction. The first floor height is 18 ft, and the second floor height is 13.6 ft. A high bay superstructure enclosure around the 20-ton crane that serves the cells is constructed with insulated aluminum siding. The high bay height is 48 ft. A rigid steel structure of I-beams and H-columns is located within the block and aluminum walls. The steel columns are partially embedded in the walls. The exposed steel is not coated with fire-resistive insulation. The steel framework supports a metal deck roof. The metal roof deck is covered with built-up overlay consisting of insulation, tar, and gravel. The roof deck is classified by National Fire Protection Association (NFPA) code as a Class 2 combustible roof. Metal ladders near the southeast corner of the building and the northwest corner of the building provides access to the flat roof. Floor assemblies are poured-in-place concrete. The first floor is slab-on-grade, and the second floor's concrete thickness varies from 5 inches to 12 inches. This building is windowless except for windows in doors. Modifications were made to the building in 1992 based on the findings of a 1989 Seismic Evaluation to implement recommendations of this study. The building is now expected to be able to withstand a severe earthquake. Utilities for the facility include electrical power, potable water, process water, steam, and plant air.

General floor plans for Building 3517 are shown in Figs. 1 and 2. The operating area consists of nine process cells (numbered 1 through 9), ten manipulator and service cells (numbered 10 through 18, and 20), and four tank farm cells (numbered 21 through 24). There is no longer a cell numbered 19. It was completely decontaminated and dismantled in order to allow placement of electropolisher tanks and controls. The electropolisher is no longer in use and the power supplies to it have been removed.

The four tank farm cells, cells 21 through 24, and two pipe tunnels are located underground adjacent to Building 3517. The tank farm cells are outside the building (although inside the facility footprint) on the north side. The tops of the concrete shield plugs over the cells are exposed to the environment.

Cells

The main cell area, cells 1 through 15, is a double cellblock located on the first level. These cells are massive, steel reinforced concrete hot cells with 3 to 4-ft thick walls. Access to the cells consists of removable reinforced concrete plugs in the tops of the cells that open to the high bay. Cell 15 also has a small access door that is on its south wall. Individual cells are separated from each other by two-ft thick concrete walls. The four tank farm cells (21 through 24) are located underground and adjacent to the main building structure and are shielded by the equivalent of 4-ft of concrete. The low-level service cells, cells 16, 17, 18, and 20, and the service area have less shielding.

1.3 CONFINEMENT SYSTEMS

Building 3517 is served by two ventilation systems: the Cell Ventilation System (CVS) and the Process Off-Gas System (POG). The CVS provides negative pressure to the hot cells. In-leakage into the hot cells keeps the rest of the building (except the airlocks) under negative pressure relative to the outside pressure. An air inlet damper located on the west side of the second level acts as a vacuum relief device, preventing pressure within the building from becoming too negative. The building is sealed and equipped with airlock entries for personnel and vehicles. The air-lock doors are gasketed. Cell ventilation exhaust air passes through 30 inch diameter concrete ducts to the filters in the underground filter pit, Building 3547, and Building 3548 filter houses. The exhaust then passes through 30 inch diameter metal ducting to the Building 3623 filter house prior to being discharged through the ORNL 3039 stack. The filters in Building 3623 are HEPA filters. The filters in Buildings 3547 and 3548, while HEPA filters, are considered roughing filters. Exhaust fans are part of the ORNL 3039 stack ventilation system. The 3517 CVS boundary ends with the outlet dampers from the 3623 filter house. A schematic diagram of the CVS is shown in Fig. 3.

The process off-gas (POG) system keeps the LLLW tanks in Cells 23 and 24 under negative pressure with respect to Cells 23 and 24, inhibiting migration of contamination from the tanks into the cells. Exhaust from the process off-gas system goes to the scrubber in Building 3092 and then exhausts through the ORNL 3039 stack. The 3517 process off-gas system ends where the ducts exit the building. Building 3092 is not considered part of Building 3517, is not analyzed in or credited in the DSA.

3517 Cell Ventilation System

In accordance with Limiting Condition of Operation (LCO) 3.1.1 (Building 3517 Cell Ventilation System) of the Building 3517 TSR, an OPERABLE Cell Ventilation System consists of the following:

- The differential pressure between each Manipulator Hot Cell (10E, 10W, 11, 12, 13, 14E, 14W and 15) in an applicable MODE (OPERATION or STANDBY) and the operating area of Building 3517 shall be greater than or equal to 0.3 inches w.g. (except when a Manipulator or Process Hot Cell cover is removed),
- A local alarm for the Manipulator Hot Cells low differential pressure (except when a Manipulator or Process Hot Cell cover is removed or if no manipulator cells are in an applicable MODE),
- The differential pressure between the interior of Building 3517 and the outside air pressure shall be greater than or equal to 0.1 inches w.g. on all four (4) differential pressure instruments,
- The differential pressure across each of the two (2) on-line Building 3623 HEPA Filter stages shall be greater than or equal to 0.5 inches w.g., and less than or equal to 5 inches w.g., and
- Each on-line Building 3623 HEPA Filter stage efficiency shall be greater than or equal to 90%.

The DSA and TSR identify the negative pressure in the manipulator cells and building, as well as the 3623 HEPA filters as credited safety controls. The following CVS components play a significant role in maintaining this credited safety system. Alteration or failure of these components could adversely affect the ability of the system to perform its safety function.

- the manipulator hot cells,
- the system inlet air damper located above Cell 15,
- the manipulator hot cell differential pressure (DP) gauges and associated low-limit alarm*,
- the secondary confinement DP gauges*,
- the ventilation ductwork from the manipulator cells to the 3623 HEPA filter housings,
- the 3547 filter house and inlet damper from manipulator hot cells,
- the 3548 filter housing and outlet dampers,
- the 3623 HEPA filters,
- the 3623 filter housing and inlet and outlet dampers,
- the 3623 HEPA filter stage DP gauges*.

* denotes components credited in the DSA and TSR.

The following CVS components play a support role in maintaining this credited safety system as a control.

- The process hot cells
- The ductwork to the process hot cells, including dampers.

The following components have no role in maintaining this credited safety system as a control.

- the process hot cell DP gauges and alarms,
- the building DP pressure switches and alarms,
- all in-cell filters**,
- the 3547 filters**.

- the 3547 filter DP gauges,
- the 3548 filters**, and
- the 3548 filter DP gauges.

** their role as a filtration device has no effect; their role as a variable resistance element in the duct system could have an effect, (i.e., when loaded).

The negative pressure of the hot cells (process and manipulator) relative to operating areas of the building provides the primary confinement of the building. The ORNL CVS (supplied from the plant stack area) creates this negative pressure. Each cell is equipped with a differential pressure gauge that is read by the facility operations personnel to verify that the cells are providing adequate confinement. The gauges are equipped with audible alarms that provide warnings of differential pressure loss in the cell. In addition, the gauges are calibrated in accordance with facility requirements. The manipulator hot cell airflow is directed to the exhaust portion of the ventilation system. The exhaust is routed through one of two parallel HEPA filter banks, each equipped with two filter stages. HEPA filters provide reduction of radioactive particulate emissions. Each HEPA filter stage is capable of providing the necessary filtering and confinement function during Building 3517 operations. The HEPA filter stages are routinely leak tested to determine the adequacy of the filtering function.

Secondary confinement (negative pressure differential of the building relative to the outside atmosphere) in Building 3517 is provided by air in-leakage into the manipulator and process cells (provided by cell ventilation). The building is maintained at a negative pressure relative to atmosphere. The building is equipped with differential pressure gauges at multiple locations that are used to monitor secondary confinement. The differential pressure gauges are calibrated in accordance with facility requirements. Exhaust from the CVS receives HEPA filtration, thereby mitigating consequences to on-site workers and the public from releases inside the building by removing most of the airborne contamination

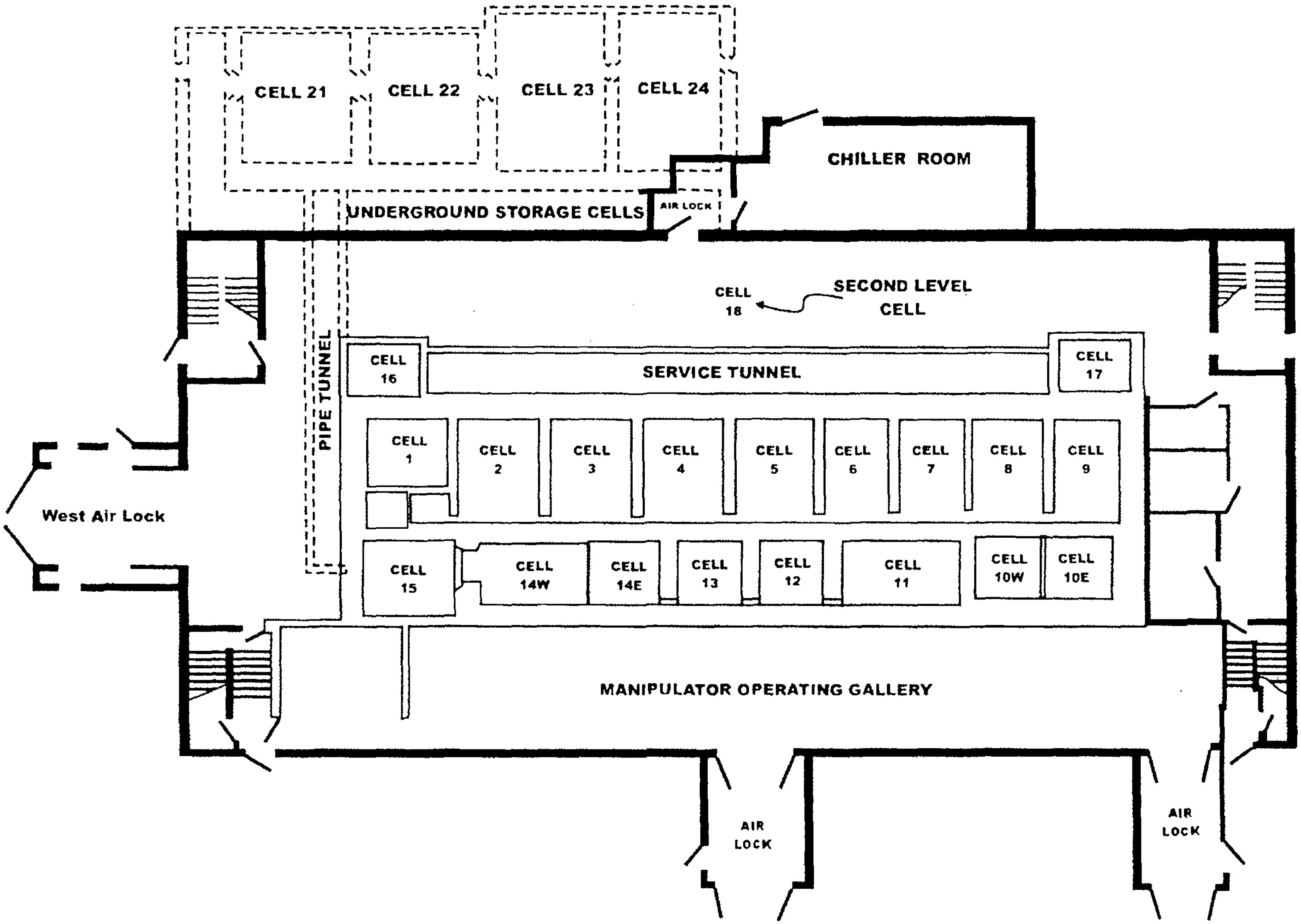

Fig. 1. First floor building 3517

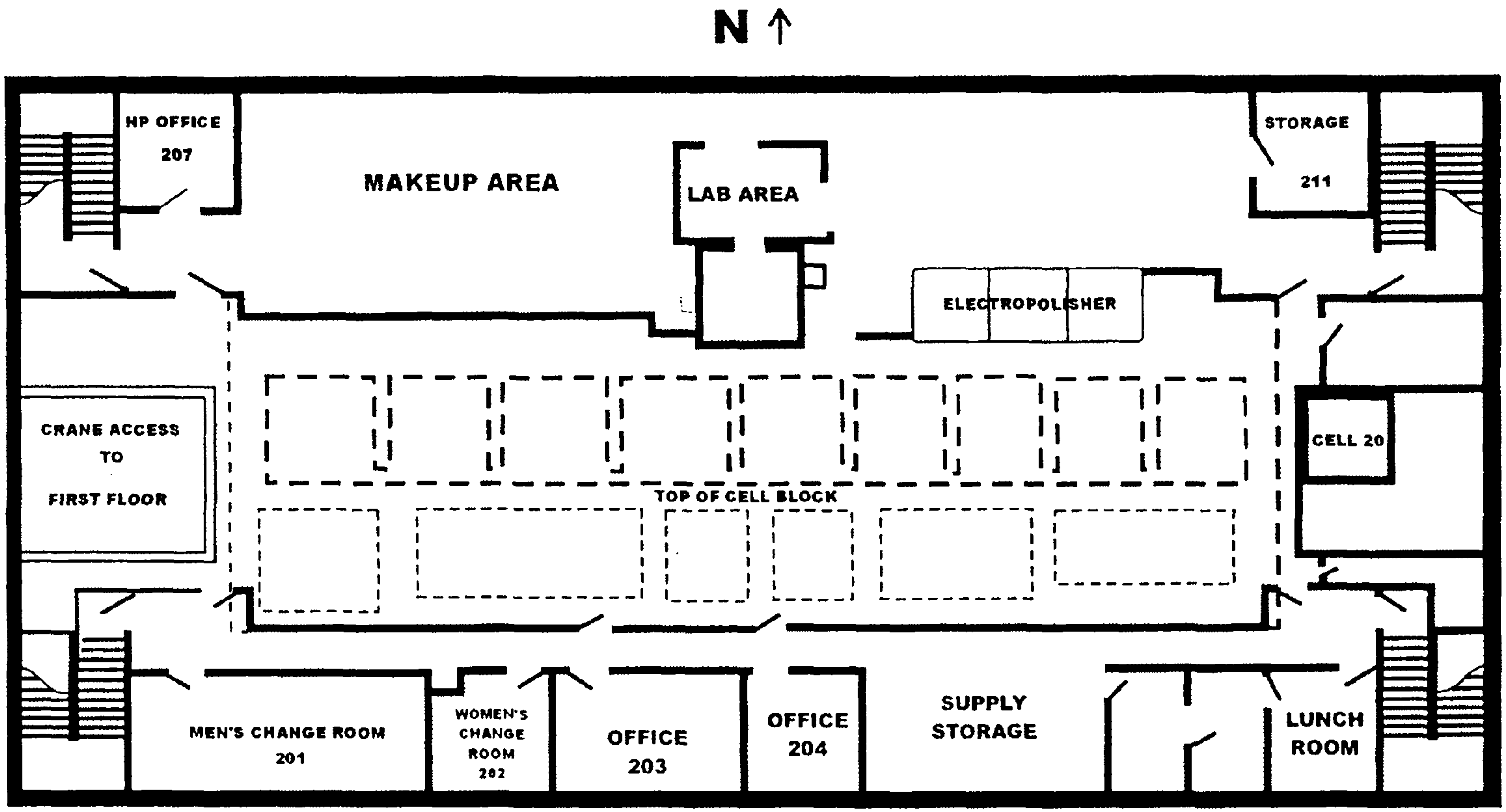

Fig. 2. Second floor building 3517

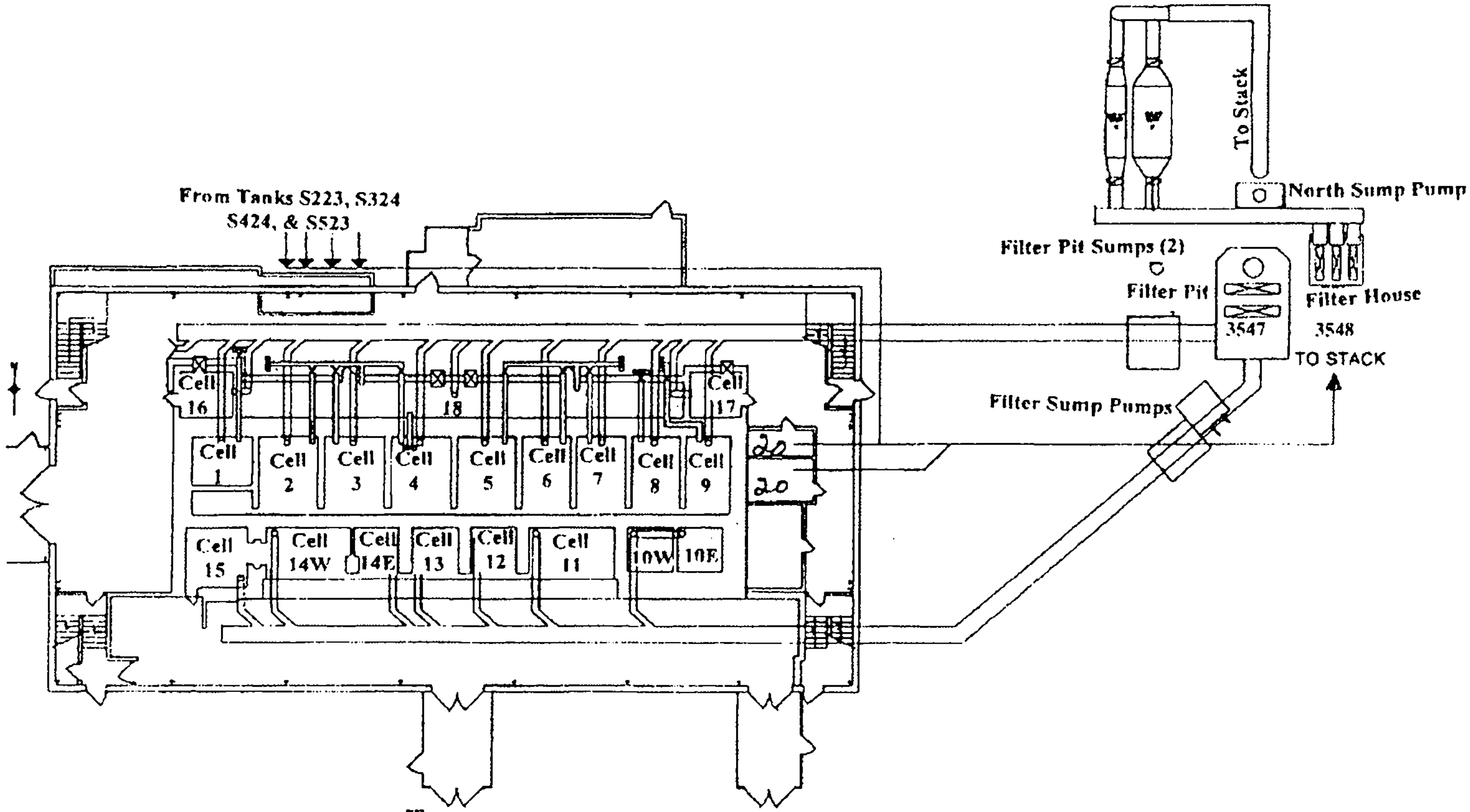

Fig. 3. Schematic of the 3517 Cell Ventilation System

1.4 MAJOR MODIFICATIONS

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

2. FUNCTIONAL CLASSIFICATION ASSESSMENT

2.1 EXISTING CLASSIFICATION

The system is currently classified as a safety significant system in the Documented Safety Analysis (DSA).

2.2 EVALUATION

The system was evaluated per Deliverable 8.5.4 and 8.7 of the Implementation Plan for DNFSB 2004-2, *Ventilation System Evaluation Guidance for Safety-Related and Non-Safety – Related Systems*. Table 4.3 from the guidance was completed, provides the information collected for the classification review, and is attached as Appendix A.

The determination of bounding unmitigated consequences presented in the DSA was reviewed by the Facility Evaluation Team (FET). It was determined that the quantitative dose consequences are determined in accordance with DOE-STD-3009-94 and do not challenge the evaluation criteria. Specific performance criteria include maintaining sufficient DP across the 3517 building and the 3517 cells, the 3517 Building and the outside pressure, and across the Building 3623 HEPA filter stages are included in the TSR in an LCO. In addition to the differential pressures, operability of the CVS depends on the audibility of the 3517 cell DP alarm as well as HEPA filter efficiency.

2.3 SUMMARY

The FET concluded that the CVS, HEPA filtered ventilation system associated with Building 3517 is appropriately and conservatively classified as safety significant.

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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 facility 3517 CVS was evaluated against the safety significant criteria defined in the evaluation guidance document.

The following gaps were identified:

- Materials of construction.
- No real-time monitoring for final filter breakthrough.
- CVS is not designed or credited to withstand an event where the building, hot cells or ductwork integrity is lost.

3.2 GAP EVALUATION

3.2.1 Materials of Construction

Some of the ductwork that runs underground is made of Reinforced Concrete Pipe. Though this material does not specifically meet the recommendation from DOE Handbook for ductwork (all-welded stainless or carbon steel construction), but has a fairly good resistance to corrosion and continues to increase in strength with age. The air ducted through these pipes is non-corrosive ambient air carrying particulate matter, this somewhat reduces the need for the corrosion protection properties of stainless steel. As such, the identified gap is determined to be acceptable based on the similar nature of the material and the fact that non-corrosive air passes through the ducting.

3.2.2 No real-time monitoring of final filter (Building 3623) break through

The final filter located in Building 3623 has DP gauges monitoring the status of the filter. These gauges are checked visually on a set schedule (weekly) in accordance with the TSR. The frequency of the checks is based on engineering judgment, operational history and the fact that even when radiological material handling is not in progress a potential fire in Manipulator Cell 14E and 14W is still a hazard. Since no activities are routinely conducted in these cells, the likelihood of a fire event during a weekly period is low. There are currently no audible alarms or warning lights that turn on or sound when the credited differential pressure values are exceeded. The motive power for the CVS comes from a remotely operated location (Stack 3039).

A filter break through would result in an increase in airflow being evacuated. This would increase the cell and building DPs, but may not set off the audible alarms associated with the 3517 building and cell differential pressures. The filter break though would be seen as a much reduced filter DP on the monitoring gauges and would induce corrective action at next cyclic inspection.

Modifications to the Building 3623 filter to provide real time monitoring have not been made and none are planned, primarily due to the age and current mission of the facility. The final filter in Building 3623 is preceded by two sets of non-credited roughing filters located in underground filter pit (Building 3547) and above ground structure (Building 3548). These filters are HEPA quality filters and as defense-in-depth components serve to reduce/prevent contamination release through stack 3039 in case of a 3623 filter break through, but are not credited in the DSA as providing any mitigation to releases. As such, the identified gap is determined to be acceptable.

3.2.3 CVS is not designed or credited to withstand an event where the building, hot cells or ductwork integrity is lost

Modifications were made to the building in 1992 based on the findings of a 1989 Seismic Evaluation to implement recommendations of this study. The building is now expected to be able to withstand a severe earthquake. The cells are massive with 4 foot thick concrete walls therefore the likelihood of a cell being breached is very low. However, the ductwork above and below ground can be affected by natural phenomenon and be breached. Modifications have not been made to the existing ductwork and none are planned, primarily due to the age and current mission (S&M) of the facility. As the mission of the facility changes to deactivation and decommissioning (D&D), modifications to the building and system would be re-evaluated. The DSA recognizes that the building, cells, and ductwork may not survive natural phenomena events and does not credit the CVS with mitigating the release. As such, the identified gap is determined to be acceptable.

3.3 MODIFICATIONS AND UPGRADES

No modifications are recommended at this time primarily due to the age, current mission and future plans to deactivate and decommission the 3517 facility. The identified gaps in the criteria are considered acceptable because of the non-corrosive air passing through the system, periodic monitoring of the credited filters, and the system is not credited with withstanding events where the building or cells are damaged (not considered to be mandatory based on the DSA).

4. CONCLUSION

In conclusion, the CVS for Building 3517 is conservatively managed as a safety significant system. While there are some gaps identified from the ventilation evaluation criteria comparison, the associated criteria were not considered mandatory and these issues are adequately addressed in the current configuration and operation.

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5. REFERENCES

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

BJC 2004, 3517 Cell Ventilation System Description, BJC/OR-1446, Revision 2, February, 2004

BJC 2006a, Documented Safety Analysis for Building 3517, Fission Product Development Laboratory, Oak Ridge National Laboratory, Oak Ridge, Tennessee (DSA-OR-3517-0013, Revision 6), February 2006.

BJC 2006b, Technical Safety Requirements for Building 3517, Fission Products Development Laboratory, Oak Ridge National Laboratory, Oak Ridge, Tennessee (TSR-OR-3517-0013, Revision 10), April 2006.

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APPENDIX A

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Table 4-3 Data Collection Table
Confinement Documented Safety Analysis Information

Facility: Building 3517			Hazard Category 2				Performance Expectations			
Bounding Accidents	Type Confinement		Doses Bounding unmitigated/ mitigated	Confinement Classification			Function	Functional Requirements	Performance Criteria	Compensatory Measures
	Active	Passive		SC	SS	DID				
DSA - Loss of Container Drop While Lifting a Cask/RTG to or from the High Bay (FPDL-6) Initial condition -- material in the Sentry RTG is not releasable	X		Unmitigated Public - <1 rem Collocated Worker - 30 rem (>25 rem but <100 rem) Mitigated Public - <<1 rem Collocated Worker - <1 rem		X		Maintain the direction of airflow inside the building from the accessible areas of the building into the hot cells. Maintain the direction of airflow between the building and the environment toward the building. Provide filtration with a minimum 90% efficiency for the exhaust from the building before it is released to the environment.	Hot cells be maintained at a negative pressure relative to the surrounding areas of the building The building is maintained at a negative pressure relative to the outside ambient pressure. Filters are not plugged and that the filtering efficiency of the HEPA filter stages is maintained greater than or equal to 90%.	Measured pressure differential between the hot cells and the rest of the building is greater than or equal to 0.3 inches of water. Maintaining a measured pressure differential of at least 0.3 inches water ensures that the actual pressure in the hot cells is at least 0.2 inches of water below the pressure in the adjacent areas of the facility. Measured pressure differential between the building and the environment is greater than or equal to 0.1 inches of water. Maintaining a measured pressure differential of at least 0.1 inches of water ensures that the actual pressure in the building is at least 0.08 inches of water below the outside ambient pressure. The efficiency of each on-line Building 3623 HEPA Filter stage shall be greater than or equal to 90% when the efficiency of the filters is periodically evaluated. However, since the efficiency of the filters cannot be continuously monitored, an additional parameter must be monitored to ensure that this functional requirement is being met. Therefore, the measured differential pressure across each of the on-line filters at Building 3623 is maintained between 0.5 and 5 inches of water. The low indicated differential pressure limit (greater than or equal to 0.5 inches of water) provides adequate indication that the filter has not been breached or that the seal has not failed and therefore, is in place to perform its safety function to filter radionuclide particulate from the exhaust. The maximum actual differential pressure that the Building 3623 HEPA filters are designed to withstand is 10 inches of water. Therefore an indicated differential pressure of 5 inches of water is used to indicate that the Building 3623 HEPA filter is loaded and must be replaced but is still capable of performing its safety function and provides sufficient operational margin while ensuring the filters are maintained and operable to perform their safety function.	None

Table 4-3 Data Collection Table
Confinement Documented Safety Analysis Information

Facility: Building 3517			Hazard Category 2				Performance Expectations			
Bounding Accidents	Type Confinement		Doses Bounding unmitigated/ mitigated	Confinement Classification			Function	Functional Requirements	Performance Criteria	Compensatory Measures
	Active	Passive		SC	SS	DID				
DSA - Cell 10 Spill Event (FPDL-7)	X		Unmitigated Public 1 rem Collocated Worker - >100 rem Mitigated Public <<1 rem Collocated Worker - 10 rem which is <25 rem		X		Maintain the direction of airflow inside the building from the accessible areas of the building into the hot cells. Maintain the direction of airflow between the building and the environment toward the building. Provide filtration with a minimum 90% efficiency for the exhaust from the building before it is released to the environment.	Hot cells be maintained at a negative pressure relative to the surrounding areas of the building The building is maintained at a negative pressure relative to the outside ambient pressure. Filters are not plugged and that the filtering efficiency of the HEPA filter stages is maintained greater than or equal to 90%.	Measured pressure differential between the hot cells and the rest of the building is greater than or equal to 0.3 inches of water. Maintaining a measured pressure differential of at least 0.3 inches water ensures that the actual pressure in the hot cells is at least 0.2 inches of water below the pressure in the adjacent areas of the facility. Measured pressure differential between the building and the environment is greater than or equal to 0.1 inches of water. Maintaining a measured pressure differential of at least 0.1 inches of water ensures that the actual pressure in the building is at least 0.08 inches of water below the outside ambient pressure. The efficiency of each on-line Building 3623 HEPA Filter stage shall be greater than or equal to 90% when the efficiency of the filters is periodically evaluated. However, since the efficiency of the filters cannot be continuously monitored, an additional parameter must be monitored to ensure that this functional requirement is being met. Therefore, the measured differential pressure across each of the on-line filters at Building 3623 is maintained between 0.5 and 5 inches of water. The low indicated differential pressure limit (greater than or equal to 0.5 inches of water) provides adequate indication that the filter has not been breached or that the seal has not failed and therefore, is in place to perform its safety function to filter radionuclide particulate from the exhaust. The maximum actual differential pressure that the Building 3623 HEPA filters are designed to withstand is 10 inches of water. Therefore an indicated differential pressure of 5 inches of water is used to indicate that the Building 3623 HEPA filter is loaded and must be replaced but is still capable of performing its safety function and provides sufficient operational margin while ensuring the filters are maintained and operable to perform their safety function.	None

Table 4-3 Data Collection Table Confinement Documented Safety Analysis Information											
Facility: Building 3517			Hazard Category 2				Performance Expectations				
Bounding Accidents	Type Confinement		Doses Bounding unmitigated/ mitigated	Confinement Classification			Function	Functional Requirements	Performance Criteria	Compensatory Measures
	Active	Passive		SC	SS	DID				
DSA - Localized Fire in Cell 14E/14W (FPDL-27) A localized fire originating within manipulator Cells 14E and 14W that does not propagate outside Cells 14E and 14W	X		Unmitigated Public - <1 rem Collocated Worker - 20 rem Mitigated Public - <<1 rem Collocated Worker - 2 rem which is <25 rem		X		Maintain the direction of airflow inside the building from the accessible areas of the building into the hot cells. Maintain the direction of airflow between the building and the environment toward the building. Provide filtration with a minimum 90% efficiency for the exhaust from the building before it is released to the environment.	Hot cells be maintained at a negative pressure relative to the surrounding areas of the building The building is maintained at a negative pressure relative to the outside ambient pressure. Filters are not plugged and that the filtering efficiency of the HEPA filter stages is maintained greater than or equal to 90%.	Measured pressure differential between the hot cells and the rest of the building is greater than or equal to 0.3 inches of water. Maintaining a measured pressure differential of at least 0.3 inches water ensures that the actual pressure in the hot cells is at least 0.2 inches of water below the pressure in the adjacent areas of the facility. Measured pressure differential between the building and the environment is greater than or equal to 0.1 inches of water. Maintaining a measured pressure differential of at least 0.1 inches of water ensures that the actual pressure in the building is at least 0.08 inches of water below the outside ambient pressure. The efficiency of each on-line Building 3623 HEPA Filter stage shall be greater than or equal to 90% when the efficiency of the filters is periodically evaluated. However, since the efficiency of the filters cannot be continuously monitored, an additional parameter must be monitored to ensure that this functional requirement is being met. Therefore, the measured differential pressure across each of the on-line filters at Building 3623 is maintained between 0.5 and 5 inches of water. The low indicated differential pressure limit (greater than or equal to 0.5 inches of water) provides adequate indication that the filter has not been breached or that the seal has not failed and therefore, is in place to perform its safety function to filter radionuclide particulate from the exhaust. The maximum actual differential pressure that the Building 3623 HEPA filters are designed to withstand is 10 inches of water. Therefore an indicated differential pressure of 5 inches of water is used to indicate that the Building 3623 HEPA filter is loaded and must be replaced but is still capable of performing its safety function and provides sufficient operational margin while ensuring the filters are maintained and operable to perform their safety function.	None

Table 4-3 Data Collection Table Confinement Documented Safety Analysis Information										
Facility: <u>Building 3517</u>			Hazard Category 2				Performance Expectations			
Bounding Accidents	Type Confinement		Doses Bounding unmitigated/ mitigated	Confinement Classification			Function	Functional Requirements	Performance Criteria	Compensatory Measures
	Active	Passive		SC	SS	DID				
DSA - Dropped Cask Breaks Through a Hot Cell Shield Plug (FPDL-44).	X		<u>Unmitigated</u> Public - 1 rem Collocated Worker - >100 rem <u>Mitigated</u> Public <<1 rem Collocated Worker - <1 rem which is <25 rem		X		Maintain the direction of airflow inside the building from the accessible areas of the building into the hot cells. Maintain the direction of airflow between the building and the environment toward the building. Provide filtration with a minimum 90% efficiency for the exhaust from the building before it is released to the environment.	Hot cells be maintained at a negative pressure relative to the surrounding areas of the building The building is maintained at a negative pressure relative to the outside ambient pressure. Filters are not plugged and that the filtering efficiency of the HEPA filter stages is maintained greater than or equal to 90%.	Measured pressure differential between the hot cells and the rest of the building is greater than or equal to 0.3 inches of water. Maintaining a measured pressure differential of at least 0.3 inches water ensures that the actual pressure in the hot cells is at least 0.2 inches of water below the pressure in the adjacent areas of the facility. Measured pressure differential between the building and the environment is greater than or equal to 0.1 inches of water. Maintaining a measured pressure differential of at least 0.1 inches of water ensures that the actual pressure in the building is at least 0.08 inches of water below the outside ambient pressure. The efficiency of each on-line Building 3623 HEPA Filter stage shall be greater than or equal to 90% when the efficiency of the filters is periodically evaluated. However, since the efficiency of the filters cannot be continuously monitored, an additional parameter must be monitored to ensure that this functional requirement is being met. Therefore, the measured differential pressure across each of the on-line filters at Building 3623 is maintained between 0.5 and 5 inches of water. The low indicated differential pressure limit (greater than or equal to 0.5 inches of water) provides adequate indication that the filter has not been breached or that the seal has not failed and therefore, is in place to perform its safety function to filter radionuclide particulate from the exhaust. The maximum actual differential pressure that the Building 3623 HEPA filters are designed to withstand is 10 inches of water. Therefore an indicated differential pressure of 5 inches of water is used to indicate that the Building 3623 HEPA filter is loaded and must be replaced but is still capable of performing its safety function and provides sufficient operational margin while ensuring the filters are maintained and operable to perform their safety function.	None

Table 4-3 Data Collection Table Explanations

Justification for Safety Significant Designation of CVS versus Safety Class Designation

The guidance provided by the U.S. Department of Energy with respect to the CVS evaluation was provided in *Ventilation System Evaluation Guidance for Safety-Related and Non-Safety-Related Systems*. This guidance provides information and direction for completing the Data Collection Table shown previously. With respect to the classification of the Cell Ventilation System (CVS), the DOE guidance states that if the bounding unmitigated dose challenges the Evaluation Guidelines (i.e., is in the range of 1-25 rem) and the classification is not safety class, provide the rationale/justification in an attachment for the lesser classification.

The unmitigated doses calculated in the Documented Safety Analysis for 3517 range from 0.3 rem to 1.0 rem. These doses were determined utilizing calculations consistent with the requirements of DOE-STD-3009, utilizing dispersion parameters corresponding to 95% meteorology conditions for Oak Ridge National Laboratory, as well as a Damage Ratio and Leak Path Factor of 1.0. The CVS in the DSA for 3517 is classified as a Safety Significant ventilation system. As such, this attachment is included to provide the rationale and justification for classifying the CVS at for 3517 as Safety Significant instead of Safety Class. The events of interest in this classification are provided in the following discussion.

Loss of Container Drop While Lifting a Cask/RTG to or from the High Bay (FPDL-6)

This event is a dropped cask or Radioisotope Thermoelectric Generator (RTG) as it is being lifted from ground level into the high bay or lowered from the high bay to the ground level (either into a manipulator cell or to First Level West). This event is mitigated by the controlling the casks (ORNL Bulk Isotope and Schaich) as design features, and the CVS.

ORNL Bulk Isotope Cask and Schaich Cask/RTG are design features that provide considerable physical protection for the sources stored within it. It is judged that this cask will maintain confinement of at least 90% of its contents following a drop from a height between 20 and 30 ft, thereby reducing the DR for this cask from 1.0 (unmitigated) to 0.1 (mitigated).

The cell ventilation system is credited since airborne material released inside the cell is exhausted through the CVS. Specifically High Efficiency Particulate Air (HEPA) filtration and the CVS negative pressure are credited.

- The CVS maintains a pressure differential between the hot cells and the areas that surround the hot cell structure. This pressure differential ensures that the direction of airflow is from the operating areas into the hot cells, protecting workers in the operating area from airborne material inside the not cells. The differential pressure assists in the control of airborne contaminants that might be present during work activities within the facility and keeps contaminants from migrating outside 3517.
- The HEPA filters of the CVS are designed to remove 99.97% of the airborne particulates. However, the analysis conservatively assumes that only 90% of the respirable particulates are removed.

A release in a cell is vented by the CVS, through the HEPA filter and stack before being released to the environment. The confinement of the cell protects the facility worker while the HEPA filter and release from the stack will dilute the release and protect the collocated worker and public. The Continuous Air Monitors (CAMs) and Facility Radiation Monitoring System (FRMS) are relied on to alert workers in other areas of the building to promptly evacuate, reducing the consequences to the collocated worker. The analysis used for this event is discussed in more detail in this section to demonstrate the conservative nature of the analysis that led to classifying the CVS as Safety Significant and not Safety Class.

The ventilation system on-line HEPA filter stages are used to filter airborne contamination prior to exhausting the ventilation air to the atmosphere. The filtering efficiency is periodically evaluated to ensure the filtering function is within assumed limits. The HEPA filters of the cell ventilation system are designed to remove 99.97% of the airborne particulates. The analysis conservatively assumes that they only remove 90% of the respirable particulates. Therefore, by crediting the negative pressure and HEPA filtration, the LPF for this event is reduced from 1.0 (unmitigated) to 0.1 (mitigated).

The maximum dose to the public for Event FPDL-6 is estimated to be about 0.4 rem. The event involves either the Bulk Isotope or Schaich Cask/RTG. This dose is not considered to challenge the guideline when consideration is taken for the conservatism built into the analysis. The multiple conservatisms built into this estimate (e.g., assuming the most heavily loaded cask is involved, not crediting the source cladding, neglecting the confinement provided by the building, assuming a ground instead of a stack release, etc.) as well as remaining consistent with the methodology of DOE-STD-3009, could result in a reduction of the dose by an order of magnitude.

Cell 10 Spill Event (FDPL-7)

This event is a spill of all the sources in Cell 10. This event is mitigated by the cell ventilation system since airborne material released inside the cell is exhausted through the CVS. Specifically HEPA filtration and the CVS negative pressure are credited.

- The CVS maintains a pressure differential between the hot cells and the areas that surround the hot cell structure. This pressure differential ensures that the direction of airflow is from the operating areas into the hot cells, protecting workers in the operating area from airborne material inside the not cells. The differential pressure assists in the control of airborne contaminants that might be present during work activities within the facility and keeps contaminants from migrating outside 3517.
- The HEPA filters of the CVS are designed to remove 99.97% of the airborne particulates. However, the analysis conservatively assumes that only 90% of the respirable particulates are removed.

A release in a cell is vented by the CVS, through the HEPA filter and stack before being released to the environment. The confinement of the cell protects the facility worker while the HEPA filter and release from the stack will dilute the release and protect the collocated worker and public. The analysis used for this event is discussed in more detail in this section to demonstrate the conservative nature of the analysis that led to classifying the CVS as Safety Significant and not Safety Class.

Most of the sources in the cell are kept in the storage well, where they are not vulnerable to being spilled. However, since there is no mechanism to prevent all of the sources in the cells from being outside the storage well, the consequences of this event are conservatively based on the bounding spill involving 100% of the sources potentially present in the cell. However, when evaluating the frequency of spill events, all types of spill events are considered, not just the improbable spill involving all of the sources. This event is conservatively assumed to occur after the barricade bottles from Building 3038 have been brought to Building 3517, and that all of the barricade bottles are being staged in Cell 10 at the time of the accident.

The maximum dose to the public for Event FPDL-7 is estimated to be about 1.0 rem. The event involves all of the cask sources (approximately 70,000 Ci ^{90}Sr EID) and the contents of the barricade bottles (approximately 700 Ci ^{90}Sr EID), as well as the sources currently stored in the Cell 10W storage well (approximately 70,000 Ci ^{90}Sr EID). This dose is not considered to challenge the guideline when consideration is taken for the conservatism built into the analysis. The multiple conservatisms built into this estimate (e.g., assuming all of the sources are involved, not crediting the source cladding, neglecting the confinement provided by the building, assuming a ground instead of a stack release, etc.) as well as remaining consistent with the methodology of DOE-STD-3009, could result in a reduction of the dose by an order of magnitude.

Localized Fire in Cell 14E/14W (FPDL-27)

This event is a fire originating within manipulator Cells 14E and 14W that does not propagate outside Cells 14E and 14W. These cells contain appreciable quantity of radioactive combustibles. This event is mitigated by the CVS. The CVS is credited since airborne material released inside the cell is exhausted through the CVS. Specifically HEPA filtration and the CVS negative pressure are credited.

- The CVS maintains a differential pressure across the secondary confinement (the physical boundary separating the interior of Building 3517 from the outside). The differential pressure assists in the control of airborne contaminants that might be present during work activities within the facility and keeps contaminants from migrating outside of Building 3517.
- The HEPA filters of the CVS are designed to remove 99.97% of the airborne particulates. However, the analysis conservatively assumes that only 90% of the respirable particulates are removed.

A release in a cell is vented by the CVS, through the HEPA filter and stack before being released to the environment. The confinement of the cell protects the facility worker while the HEPA filter and release from the stack will dilute the release and protect the collocated worker and public. The analysis used for this event is discussed in more detail in this section to demonstrate the conservative nature of the analysis that led to classifying the CVS as Safety Significant and not Safety Class.

The ventilation system on-line HEPA filter stages are used to filter airborne contamination prior to exhausting the ventilation air to the atmosphere. The filtering efficiency is periodically evaluated to ensure the filtering function is within assumed limits. The HEPA filters of the cell ventilation system are designed to remove 99.97% of the airborne particulates. The analysis conservatively assumes that they only remove 90% of the respirable particulates. Therefore, by crediting the negative pressure and HEPA filtration, the LPF for this event is reduced from 1.0 (unmitigated) to 0.1 (mitigated).

Since the fire occurs in a cell workers in other parts of the facility may not immediately aware of the fire and need to evacuate. As such, the CAMs and FRMS are credited for alerting facility workers to evacuate on high airborne in the facility.

The maximum dose to the public for this event is estimated to be about 0.3 rem. The event involves of the containerized trash in Cells 14E and 14W (approximately 5,000 Ci ^{90}Sr EID) and all of the radioactive contamination in Cells 14E and 14W (approximately 1,000 Ci ^{90}Sr EID). This dose is not considered to challenge the guideline when consideration is taken for the conservatism built into the analysis. The multiple conservatisms built into this estimate (e.g., assuming the all of the containers in the cell are burned, neglecting the confinement provided by the building, assuming a ground instead of a stack release, etc.) as well as remaining consistent with the methodology of DOE-STD-3009, could result in a reduction of the dose by an order of magnitude.

Dropped Cask Breaks Through a Hot Cell Shield Plug (FPDL-44)

This event is a dropped cask over a hot cell shield plug. A cask being carried by the High Bay crane is dropped, lands on one of the hot cell shield plugs, and breaks through the shield plug. The cask and the rubble from the shield plug would then tumble to the bottom of the hot cell. This event is mitigated by the controlling the height of cask/RTG transfers, restricting RTG movement over manipulator cell shield plugs, the casks (ORNL Bulk Isotope and Schaich) as design features, and the CVS.

Restricting cask/RTG lifts to heights of less than 1 foot in the High Bay will reduce the probability of a cask breaking through a shield block, since the DSA states that such falls would not significantly damage the shield blocks. The requirement that casks not be carried over the shield blocks of manipulator cells reduces the probability of dropping a cask through a manipulator cell shield plug to beyond extremely unlikely, thereby excluding the inventory of the manipulator cells from event. Consequently, the mitigated Material At Risk (MAR) for this event is reduced to the contents of the dropped cask

ORNL Bulk Isotope Cask and Schaich Cask/RTG are design features that provide considerable physical protection for the sources stored within it. It is judged that this cask will maintain confinement of at least 90% of its contents following a drop from a height between 20 and 30 ft, thereby reducing the DR for this cask from 1.0 (unmitigated) to 0.1 (mitigated).

The cell ventilation system is credited since airborne material released inside the cell is exhausted through the CVS. Specifically HEPA filtration and the CVS negative pressure are credited.

- The CVS maintains a differential pressure across the secondary confinement (the physical boundary separating the interior of Building 3517 from the outside). The differential pressure assists in the control of airborne contaminants that might be present during work activities within the facility and keeps contaminants from migrating outside of Building 3517.
- The HEPA filters of the CVS are designed to remove 99.97% of the airborne particulates. However, the analysis conservatively assumes that only 90% of the respirable particulates are removed.

A release in a cell is vented by the CVS, through the HEPA filter and stack before being released to the environment. The confinement of the cell protects the facility worker while the HEPA filter and release from the stack will dilute the release and protect the collocated worker and public. The analysis used for this event is discussed in more detail in this section to demonstrate the conservative nature of the analysis that led to classifying the CVS as Safety Significant and not Safety Class.

The ventilation system on-line HEPA filter stages are used to filter airborne contamination prior to exhausting the ventilation air to the atmosphere. The filtering efficiency is periodically evaluated to ensure the filtering function is within assumed limits. The HEPA filters of the cell ventilation system are designed to remove 99.97% of the airborne particulates. The analysis conservatively assumes that they only remove 90% of the respirable particulates. Therefore, by crediting the negative pressure and HEPA filtration, the LPF for this event is reduced from 1.0 (unmitigated) to 0.1 (mitigated).

The source term reduction created by the cask and restrictions against carrying a cask over a manipulator shield plug reduce the radiological dose rate to the point where facility workers could avoid significant consequences by promptly evacuating (DR 0.1). The nature of the event would make facility workers in the immediate area of the accident immediately aware of the need to evacuate. The CAMs and Facility Radiation Monitoring System would alert workers in other areas of the building who were not immediately aware of the release of the need for prompt evacuation, significantly reducing the consequences to facility workers.

The maximum dose to the public for these events is estimated to be about 1 rem. The event involves dropping a cask through the Cell 10W shield plug. Cell 10W is the cell with the largest inventory of radioactive material. The inventory assumes that the cask sources (approximately 70,000 Ci ^{90}Sr EID) and the contents of the barricade bottles (approximately 700 Ci ^{90}Sr EID), as well as the sources currently stored in the Cell 10W storage well (approximately 70,000 Ci ^{90}Sr EID). This dose is not considered to challenge the guideline when consideration is taken for the conservatism built into the analysis. The multiple conservatisms built into this estimate (e.g., assuming all of the sources are involved (including the barricade bottles from Building 3038), not crediting the source cladding, neglecting the confinement provided by the building, assuming a ground instead of a stack release, etc.) as well as remaining consistent with the methodology of DOE-STD-3009, could result in a reduction of the dose by an order of magnitude.

Regarding when Building 3517 CVS is not expected to act as a Safety System

As discussed in Section 4.4.1.2 (System Description) of the DSA, the Cell Ventilation System may be unable to perform its intended safety functions if the building structure or hot cell structure are heavily damaged. Therefore, the system is not expected to fulfill its safety functions during events in which the building structure or hot cell structure could potentially be heavily damaged. As such, the Cell Ventilation System is not credited during the seismic event (FPDL-1), tornado (FPDL-2), large fire (FPDL-10), aircraft crash (FPDL-16), natural phenomena-induced fire (FPDL-17), explosion (FPDL-18/19), and roof collapse (FPDL-21) scenarios. Additionally, the destruction of the cell shield plug during event FPDL-44 could prevent the cell ventilation system from being able to sustain the negative pressure in the cells with respect to the ambient pressure in the building. Therefore, for event FDPL-44, only the HEPA filtration and the negative pressure in the building with respect to the outside environment are credited.

During localized fire inside hot cells, the Cell Ventilation System is not expected to be able to maintain the direction of airflow from the building into the hot cells for a prolonged period, since the soot from the fire would plug the cell's roughing filters and the heat created by the fire could cause the cells to pressurize. However, a small localized fire is not expected to produce sufficient soot to plug the main filters in Buildings 3547, 3548, and 3623. Therefore, the Cell Ventilation System is expected to be able to maintain the direction of airflow between the building and the environment into the building, and is credited with doing so in event FPDL-27 (localized fire in Cell 14E/W). The other two events for which the Cell Ventilation System is credited (FPDL-6, Container Drop While Lifting a Cask/RTG to or from the High Bay, and FPDL-7, Cell 10 Spill Event) are not expected to create any non-ambient environmental stresses that could potentially affect the opera

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APPENDIX B

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Table 5-1, Ventilation System Performance Criteria – for Bldg. 3517 CVS				
Evaluation Criteria	**Safety Significant**	**Evaluation Criteria Explained**	**System Capabilities and Characteristics**	**Reference**
Pressure differential should be maintained between zone and atmosphere.	Applies	Per DOE-HNDBK-1169, Table 2.1: • Primary: -0.3 to -1.0 in. w.g. • Secondary: -0.03 to -0.15 in. w.g. • Tertiary: -0.01 to -0.15 in. w.g. Section 2.3.1 states that system flow (and DPs) may be reduced during periods of non-operation.	The system maintains two confinement zones. Primary confinement is maintained in the manipulator hot cells. The minimum differential pressure (DP) for the manipulator hot cells is -0.3 in, w.g. The secondary confinement is the building. The minimum (DP) between the building and the outside is -0.1 in. w.g. There is no tertiary confinement system. **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 ductwork is constructed of all-welded, stainless steel above ground and Reinforced Concrete Pipe (RCP) below ground. The credited filter housings are above ground and are constructed from welded Stainless Steel. The below ground filter housings are concrete with appropriate steel and sponge rubber gasket sealed surfaces. The air stream is non-corrosive outside air. The Stainless Steel materials of construction satisfy the evaluation criteria for normal, abnormal, and accident conditions. There are no electronics that are part of the credited system. The DP gages are credited and they are a mechanical device. **The RCP does not specifically meet the recommendation of Section 4.3.3.**	DOE-HDBK-1169 (2.2.5), ASME AG-1

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) the system is expected to remain functional:
		  • Components must be capable of withstanding the differential pressures, heat, moisture, and stress with minimum damage or loss of integrity
		  • Provisions must be made for the probable occurrence of power and equipment failures, such as redundant fan/fan motors and alternate power sources.
			The cell ventilation system is to be OPERABLE at all times during normal operating conditions. The system is not credited to operate under abnormal or accident conditions that would affect the integrity of the building, the hot cells or the ductwork.
			Loss of power to the building does not affect the operability of the ventilation system because the motive force for the ventilation system is provided by the redundant fans and power in the 3039 Stack system. This is described and controlled by WM-SGWO-3039-ASA, Auditable Safety Analysis: 3039 Stack Ventilation System, Issued 9/27/00.
			The intent of the evaluation criteria is not satisfied. However, the system is not credited to operate under abnormal or accident conditions where the integrity of the building, hot cells or ductwork is lost.
				DOE-HDBK-1169 (2.4), ASHRAE Design Guide

Table 5-1, Ventilation System Performance Criteria – for Bldg. 3517 CVS (continued)				
Evaluation Criteria	**Safety Significant**	**Evaluation Criteria Explained**	**System Capabilities and Characteristics**	**Evaluation Criteria**
System should have appropriate filtration to minimize release	Applies	Per DOE-HNDBK-1169, Section 2.2.9, primary confinement zones require: • high efficiency filters, preferably HEPAs, in air inlets; and • independently testable HEPA filter stages in the exhaust. The number of stages required is determined by safety analysis. HEPA filters must be tested in-place at a prescribed frequency per ASME AG-1.	System employs single-stage HEPA filtration on exhaust flow as assumed in the safety analysis. These filters are located external to the building in Filter housing 3623. In-place efficiency tests were conducted following installation and annually per ASME N510, as required by the TSR. The minimum efficiency for the in-place test is established in the TSR as 90%. The TSR HEPA filter DP limits are 0.5 and 5.0 inches w.g. These are the minimum and maximum allowable differential pressure across the filter Air inlets in the cells have HEPA quality filters but are not credited or monitored. **The evaluation criteria are satisfied.**	DOE-HDBK-1169 (2.2.1), ASME AG-1
Provide system status instrumentation and/or alarms	Applies	Per DOE-HNDBK-1169, Section 2.4.2: • Visible and audible alarms should be provided, both locally and at a central control station, to signal the operator when a malfunction to the system has occurred. In addition, indicator lights to show the operational status of fans and controls in the system should be provided in the central control room.	The manipulator hot cells have DP gauges located on a panel in the manipulator operating area. Each hot cell has a separate DP gauge which can activate a common alarm audible throughout the building. These also show a visual alarm (light) on the facility monitoring panels located on the first and second floor. The process hot cells are not a credited part of the ventilation system. They are monitored with DP gauges because they affect the secondary confinement. **They do not have any alarms associated with them.** The building pressure relative to the outside is measured by 4 DP Gauges. Two are located on the first floor and two on the second floor. Each of these gauges can activate an alarm horn that is audible throughout the building. The credited HEPA filters are located externally in Filter housing 3623. **They are monitored with DP gauges but are not alarmed either with visual light or audible horns.** The gauges are monitored weekly. **The evaluation criterion is not entirely satisfied since there is no local or remote alarm to signal a malfunction with the credited HEPA filters.**	DOE-HDBK-1169, ASHRAE Design Guide (Section 4), ASME AG-1

Table 5-1, Ventilation System Performance Criteria – for Bldg. 3517 CVS (continued)				
Evaluation Criteria	**Safety Significant**	**Evaluation Criteria Explained**	**System Capabilities and Characteristics**	
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	Applies	While the reference does discuss post-accident monitoring, it does not discuss post-accident indication of filter break-through.	Post-accident indication of filter break-through would be indicated by a significant decrease in filter DP from the previous reading. The cell and building DP's may also be affected by a filter breakthrough, the DP's would be much higher than their typical reading giving an indication of a system malfunction but not specifically of a filter break through. The gauges would be read immediately after an accident and therefore a filter break-through would be recognized. **The intent of the evaluation criteria is satisfied.**	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.
			There are no mechanical or electronic controls associated with the building that control airflow or DP's.
			Loss of power to the building does not affect the operability of the ventilation system because the motive force for the ventilation system is provided by the redundant fans and power in the 3039 Stack system. This is described and controlled by WM-SGWO-3039-ASA, Auditable Safety Analysis: 3039 Stack Ventilation System, Issued 9/27/00 The 3039 stack system is not part of the credited 3517 ventilation system
			
			The intent of the evaluation criteria is satisfied.
				DOE-HDBK-1169 (2.4)

Table 5-1, Ventilation System Performance Criteria – for Bldg. 3517 CVS (continued)				
Evaluation Criteria	**Safety Significant**	**Evaluation Criteria Explained**	**System Capabilities and Characteristics**	**Evaluation Criteria**
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)	There are no controls either mechanical or electronic associated with 3517. **The intent of the evaluation criteria is satisfied.**	DOE-HDBK-1169 (2.4)
System should withstand credible fire events and be available to operate and maintain confinement	Applies	Per DOE-HNDBK-1169, Section 10.6: • The ventilation system filter housing construction materials should be noncombustible. • Process hazards inside and outside the ventilation filter housings should be controlled • General area sprinklers 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	The DSA does not credit the system in case of a large fire. It is only credited to operate in case of a localized fire in Cell 14. The final filter housing is separated from the main building and is constructed of stainless steel. There are no fire mitigation systems installed in the final filter housing. **There are no fire detection features or controls for the ventilation system.** **The evaluation criteria are not satisfied. However, the system is not credited in a large facility fire, only a localized fire in a cell. The credited filters are away from the facility with two non-credited HEPA filters between the cell and the credited filters.**	DOE-HDBK-1169 (10.1), DOE-STD-1066

Table 5-1, Ventilation System Performance Criteria – for Bldg. 3517 CVS (continued)

Evaluation Criteria	Safety Significant	Evaluation Criteria Explained	System Capabilities and Characteristics	Evaluation Criteria
		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.		
System should not propagate spread of fire	Applies	DOE-HNDBK-1169, Section 10 states: • The accumulation of dust and debris inside the air cleaning system ductwork over long periods of operation provides a mechanism for transporting flames from an ignition source to the filters. (Section 10.5.2.2) • Air cleaning systems should not cross fire area boundaries (Section 10.6.2.2) • Ducts penetrating fire rated barriers should be insulated or enclosed as determined by the FHA (Section 10.6.2.2) • The preferred construction materials for ductwork are steel, stainless steel, or galvanized steel. If fiberglass ductwork is needed, special ductwork meeting the flame-spread criteria in NFPA 90A is required. (Section 10.6.2.2) • Filter casings of wood construction requires a fire retardant treatment that results in a flame spread of 25 or less when tested by ASTM E-84. (Section 10.6.2.2)	The DSA does not credit the system to operate during abnormal or accident conditions. The duct and filter housings are steel and RCP. **The system does not have fire dampers or cross any fire area boundaries.** The credited filter casings are constructed of steel. The filter media meets the ASME AG-1 limit for combustible material, (i.e., the combustible material in the filter media shall not exceed 7% by weight when tested as specified in FC-I-4226). The non credited HEPA filter casings located in the below ground concrete filter house 3547 are constructed of stainless steel. **Sealing surface for the filters is "sponge rubber" The quantity of this sponge rubber is very small and would not contribute to the propagation of a fire.(No flammability specs available on the sponge rubber).** The filter media meets the ASME AG-1 limit for combustible material, (i.e., the combustible material in the filter media shall not exceed 7% by weight when tested as specified in FC-I-4226). **The evaluation criteria are satisfied.**	DOE-HDBK-1169 (10.1), DOE STD 1066

Table 5-1, Ventilation System Performance Criteria – for Bldg. 3517 CVS (continued)				
Evaluation Criteria	**Safety Significant**	**Evaluation Criteria Explained**	**System Capabilities and Characteristics**	**Evaluation Criteria**
System should safely withstand earthquakes	Applies	Per DOE-HNDBK-1169, Section 2.6: • At nuclear facilities, buildings and equipment designated Safety Class or Safety Significant are specifically designed to withstand the effects of a design basis earthquake (DBE). Per DOE-HNDBK-1169, Section 5.6.5: • Instruments used in safety-related systems must be qualified for seismic conditions per ASME AG-1, Section IA. Per DOE-HNDBK-1169, Section 9.2.2: • The DBE for the performance category (PC) of the system should be determined from Table 9.1. External components of the system (e.g. housings, fans, etc.) should be rigidly anchored to major building elements (walls, floors, partitions). The components should perform their intended functions and, if required by procurement specs, should not sustain damage during or after they are subjected to excitations resulting from ground motions due to the DBE. This seismic qualification may be achieved following any one or a combination of analysis, testing, and experience based data.	While the facility is credited with withstanding a PC-3 event, the ventilation system is not expected to survive the event. The system would certainly not survive a Design Basis Earthquake. Following an earthquake, the operability of the system would be evaluated by taking DP readings at the 3623 filter house and DPs in the building and cells. A reentry plan would enable personnel to enter the building and take the DP readings. However, the above ground ventilation ductwork to the 3039 stack is more likely to be affected by the earthquake, rendering the ventilation system at 3517 inoperable. **The evaluation criteria are not satisfied. However, the system was not designed and is not credited with withstanding an earthquake.**	DOE-HDBK-1169 (9.2), DOE O420.1B, ASME AG-1 AA
System should safely withstand tornado depressurizatio n	Applies	Per DOE-HNDBK-1169, Section 5.6.5: • Instruments used in safety-related systems must be qualified for environmental conditions per ASME AG-1, Section IA. Per DOE-HNDBK-1169, Section 9.2.4: • Wind design criteria for a tornado for the performance criteria (PC) of the system should be determined from Table 9.2. Only systems designed based on PC-3 and PC-4 are required to meet the tornado design criteria. Evaluation of	The system was not designed or credited to operate during or after a tornado. Following a tornado, the operability of the system would be evaluated by taking DP readings at the 3623 filter house and DPs in the building and cells. A reentry plan would enable personnel to enter the building and take the DP readings. However, the above ground ventilation ductwork to the 3039 stack is more likely to be affected by the tornado rendering the ventilation system at 3517 inoperable.	DOE-HDBK-1169 (9.2), DOE O420.1B

Table 5-1, Ventilation System Performance Criteria – for Bldg. 3517 CVS (continued)

Evaluation Criteria	Safety Significant	Evaluation Criteria Explained	System Capabilities and Characteristics	Evaluation Criteria
		existing systems should focus on the strengths of connections and anchorages as well as the ability of the wind loads to find a continuous path to the foundation or support system. All obvious damage sequences should be examined for progressive failures. Once the failure sequences are identified, the system performance is compared with the stated performance goals for the specified PC. See Appendix D of DOE-STD-1020 for more information.	**The evaluation criteria are not satisfied. However, the system was not designed to or is credited with withstanding a tornado.**	
System should withstand design wind effects on system performance	Applies	Per DOE-HNDBK-1169, Section 5.6.5: • Instruments used in safety-related systems must be qualified for environmental conditions per ASME AG-1, Section IA. Per DOE-HNDBK-1169, Section 9.2.4: • Wind design criteria for a tornado for the performance criteria (PC) of the system should be determined from Table 9.2. Only systems designed based on PC-3 and PC-4 are required to meet the tornado design criteria. Evaluation of existing systems should focus on the strengths of connections and anchorages as well as the ability of the wind loads to find a continuous path to the foundation or support system. All obvious damage sequences should be examined for progressive failures. Once the failure sequences are identified, the system performance is compared with the stated performance goals for the specified PC. See Appendix D of DOE-STD-1020 for more information.	The system was not designed or credited to operate during a high wind event. Following such a high wind event, the operability of the system would be evaluated by taking DP readings at the 3623 filter house and DPs in the building and cells. A reentry plan would enable personnel to enter the building and take the DP readings. However, the above ground ventilation ductwork to the 3039 stack is more likely to be affected by the high wind, rendering the ventilation system at 3517 inoperable. **The evaluation criteria are not satisfied. However, the system was not designed to or credited with withstanding the design high wind event.**	DOE-HDBK-1169 (9.2), DOE O420.1B

Table 5-1, Ventilation System Performance Criteria – for Bldg. 3517 CVS (continued)				
Evaluation Criteria	**Safety Significant**	**Evaluation Criteria Explained**	**System Capabilities and Characteristics**	**Evaluation Criteria**
System should withstand other natural phenomenon events considered credible in the DSA where system is credited	Applies	Per DOE-HNDBK-1169, Section 5.6.5: • Instruments used in safety-related systems must be qualified for environmental conditions per ASME AG-1, Section IA. Per DOE-HNDBK-1169, Section 9.2.1: • Evaluate the system based on DOE-STD-1020. The overall DOE National Phenomenon Hazard (NPH) design input, as well as applicable DOE Orders and standards are shown in Figure 9.1.	The system is not credited in the DSA or designed to operate during or after natural phenomenon events if there was damage. Following a natural phenomena event, the operability of the system would be evaluated by taking DP readings at the 3623 filter house and DPs in the building and cells. A reentry plan would enable personnel to enter the building and take the DP readings. However, the above ground ventilation ductwork to the 3039 stack is more likely to be affected by the natural phenomenon, rendering the ventilation system at 3517 inoperable. **The evaluation criteria are not satisfied. However, the system was not designed to or credited with withstanding a natural phenomena event where the building, hot cells or ductwork integrity is lost.**	DOE-HDBK-1169 (9.2), DOE O420.1B
Administrative controls to protect system from barrier-threatening events	Applies	DOE O420.1B Chapter I Section 3.b(2)(f) states: • Systems must include administrative controls to monitor facility conditions during and after an event. DOE O420.1B pg 8 states: • See DOE-STD-1186-2004, Specific Administrative Controls.	Section 5.0 of the TSR lists numerous administrative controls for protection of the work area (and adjacent facilities) from barrier-threatening events, including controls on: • ignition sources • vehicle and fork truck usage • transient combustibles • flammable liquids • hot work • personnel access **The evaluation criteria are satisfied.**	DOE O420.1B
Design supports periodic inspection and testing of filter houses; tests and inspections are conducted periodically	Applies	Per DOE-HNDBK-1169, Section 2.3.8: • Exhaust system HEPA filter installations must be tested to the requirements of ASME AG-1 Section TA, after each component change. There should be adequate space within and around the filter house to allow for inspection, testing, and maintenance of filters in a safe manner.	In-place efficiency tests are conducted annually and after filter change per ASME N510, as required by the TSR. The minimum efficiency for the in-place test is established in the TSR as 90%. Access to all components of the filter housing, instrumentation, fan, and controls for operation, maintenance, and testing is unencumbered. **The evaluation criteria are satisfied.**	DOE-HDBK-1169 (2.3.8), ASME AG-1, ASME N510

Table 5-1, Ventilation System Performance Criteria – for Bldg. 3517 CVS (continued)				
Evaluation Criteria	**Safety Significant**	**Evaluation Criteria Explained**	**System Capabilities and Characteristics**	**Evaluation Criteria**
Instrumentation required to support system operability is calibrated	Applies	Per DOE-HNDBK-1169, Section 5.6.5: • All instruments must be calibrated and tested in accordance with the manufacturer's test procedures.	The filter DP gages are the instrumentation required to support system operability. They are calibrated annually per the manufacturer's instructions and as required by the TSR Surveillance Requirements. **The evaluation criteria are satisfied.**	DOE-HDBK-1169 (2.3.8)
Integrated system performance testing is specified and performed	Applies	Per DOE-HNDBK-1169, Section 2.3.8: • Air cleaning systems designed in accordance with ASME AG-1 should be tested in accordance with ASME AG-1, Section TA. Those systems designed to ASME N509 or still covered by its 2002 maintenance revision, should be tested in accordance with the provisions of ASME N510. Other older systems not designed to either ASME AG-1 or N509 are generally tested by following the guidance in ASME N510.	In-place efficiency tests are conducted annually and after filter change per ASME N510, as required by the TSR. Access to all components of the filter housing, instrumentation, fan, and controls for operation, maintenance, and testing is unencumbered. **The evaluation criteria are satisfied.**	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 credited HEPA filters for safety significant systems within 7 years from date of installation, or when the TSR DP limit is reached—whichever occurs first. The **current credited filters located in filter housing 3623 were installed in 2002**, and have never been wetted or exposed to damaging chemicals. Significant radiological loading is not expected; however, the contact dose rate will be monitored periodically, and a replacement based on ALARA considerations would be performed if conditions warrant. **The evaluation criteria are satisfied.**	DOE-HDBK-1169 (3.1 & App C)
Failure of single component shall not affect operation	Does Not Apply	Per DOE O420.1B, Chapter I, Section 3.b(8): • Safety class electrical systems must be designed to preclude single point failure (No requirements are given for Safety Significant or Defense-in-Depth Systems.)	Not applicable. Not a safety class system.	DOE O420.1B, Chapter I, Sec. 3.b(8)

Table 5-1, Ventilation System Performance Criteria – for Bldg. 3517 CVS (continued)

Evaluation Criteria	Safety Significant	Evaluation Criteria Explained	System Capabilities and Characteristics	Evaluation Criteria
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.	There is no backup electrical power supply to the building. Emergency electrical power is not required by the safety basis documents for the CVS. **The motive power for the ventilation system is provided by the external 3039 stack system.** This is not part of the credited system. The 3039 stack system is described and controlled by WM-SGWO-3039-ASA, Auditable Safety Analysis: 3039 Stack Ventilation System, Issued 9/27/00	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.	The system has no alternate power source. Back-up electrical power is not required by the safety basis documents for the CVS. **The motive power for the ventilation system is provided by the external 3039 stack system.** This is not part of the credited system. The 3039 stack system is described and controlled by WM-SGWO-3039-ASA, Auditable Safety Analysis: 3039 Stack Ventilation System, Issued 9/27/00	DOE-HDBK-1169 (2.2.7)
Other specific functional requirements credited in the DSA	Applies		There are no other specific functional requirements credited in the DSA. The DP gauges are calibrated on a set schedule. **The evaluation criterion is satisfied.**	10 CFR 830, Subpart B

References:

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

3517 Cell Ventilation System Description, BJC/OR-1446, Revision 2, February, 2004

Technical Safety Requirements for Building 3517, Fission Products Development Laboratory, Oak Ridge National Laboratory, Oak Ridge, Tennessee (TSR-OR-3517-0013, Revision 10), April 2006.

APPENDIX C

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Field Evaluation Team Biographical Sketches

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Mr. Harding holds a BS Degree in Oceanography with minors in Physics and Ocean Engineering from the United States Naval Academy and a MS Degree in Financial Management from Rensselear Polytechnic Institute. He is a member of the Nuclear Facility Safety organization with over 30 years experience in managing nuclear reactor and non-reactor facility operations.

Sohail Aslam

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Mr. Aslam holds a BS Degree in Mechanical Engineering from University of Wisconsin, Madison, and an MS Degree in Engineering Management from the University of Tennessee in Chattanooga. He is a licensed Professional Engineer with over 25 years experience in the design and evaluation of industrial and nuclear ventilation systems and their controls.

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ACTIVE CONFINEMENT SYSTEM EVALUATION SUMMARY REPORT FOR DNFSB 2004-2

MOLTEN SALT REACTOR EXPERIMENT FACILITY, OAK RIDGE TENNESSEE

BJC/OR-2898

ACTIVE CONFINEMENT SYSTEM EVALUATION SUMMARY REPORT FOR DNFSB 2004-2

MOLTEN SALT REACTOR EXPERIMENT FACILITY, OAK RIDGE TENNESSEE

Date Issued—[September 2007]

Prepared for the
U.S. Department of Energy
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U.S. DEPARTMENT OF ENERGY

APPROVALS

Active Confinement System Evaluation Summary Report for DNFSB 2004-2

Molten Salt Reactor Experiment Facility, Oak Ridge, Tennessee)

[BJC/OR-2898]

[September, 2007]

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TABLES

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ACRONYMS

ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
CFR	Code of Federal Regulations
CVS	Containment Ventilation System
DBA	Design Basis Accidents
DNFSB	Defense Nuclear Facilities Safety Board
DOE	U.S. Department of Energy
DSA	Documented Safety Analysis
FET	Facility Evaluation Team
FSD	Fuel Salt Disposition
HEPA	High-efficiency particulate air
LCO	Limiting Condition for Operation
MSRE	Molten Salt Reactor Experiment facility
NPH	Natural Phenomena Hazards
SSC	System, Structure, and Component
STD	Standard
TSR	Technical Safety Requirement

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1. INTRODUCTION

1.1 FACILITY OVERVIEW

The Molten Salt Reactor Experiment (MSRE) was originally operated as a concept test for the use of molten salt containing uranium as the fuel for the reactor. The reactor operated in the late 1960s and was shut down in 1969. At that time, the fuel salt was removed from the reactor and stored in two fuel drain tanks in the facility. Flush salt was run through the reactor to remove residual uranium and stored in the fuel flush drain tank. These drain tanks are located in a below grade cell next to the reactor cell. The fuel and flush salt was allowed to cool and solidify. The Containment Ventilation System (CVS) was designed to vent the secondary containment structures, principally the reactor cell, drain tank cell and other service cells, during the reactor experiment. The system continued to operate in this capacity until the current fuel salt disposition (FSD) project was initiated to remove the uranium from the salts. The CVS was augmented to provide secondary confinement for process equipment. The process equipment includes the equipment to sparge the salt, remove the fuel as uranium hexafluoride (UF_6), and trap the UF_6.

The CVS is credited in the MSRE Technical Safety Requirements (TSR) for ventilation of eight confinement enclosures containing process piping and equipment. These enclosures are located in operating areas and are vented to mitigate potential exposures to facility workers should there be a release of hazardous process gas inside the enclosure. One important note about the MSRE CVS involves the name "containment" ventilation system. The credited function of the CVS is more as a confinement system in that it does not necessarily contain all releases into its ducts and enclosures.

The CVS enclosures are steel cabinets and glove boxes. The exhaust ducts from these enclosures are steel pipes which connect to the original steel ductwork of the CVS. There are three main (last-in line) parallel filter banks located outside the process building in concrete beds. Each bank consists of a bank of roughing filters and a bank of High Efficiency Particulate Air (HEPA) filters. The filter banks are connected to two fans which exhaust to a single 100 ft. stack. The system generally operates with two filter banks in service and one fan operating.

1.2 CONTAINMENT VENTILATION SYSTEM/STRATEGY

The MSRE CVS is credited to protect facility workers from potential releases of hazardous gases (e.g., F_2, HF, and UF_6). Since release of significant quantities of process gases is possible only during certain fuel disposition processes, the CVS is only credited for these specific operations. The applicable processes are Fluorination, Hydrofluorination, UF_6 Transfer, and Reagent Gas [TSR, Limiting Condition for Operation (LCO) 3.1.1] during Operation mode. The minimum differential pressure associated with each CVS enclosure is designated to correspond to a ventilation flow rate sufficient to remove any anticipated release within the enclosure. The CVS enclosure pressures are monitored daily when an applicable process is in Operation Mode. The checks ensure the credited minimum flow exists in the enclosures. A failure of the CVS results in a loss of vacuum at the main filter pit. The main filter pit is equipped with pressure switches that initiate an alarm when the vacuum drops to less than 1 in. w.g.

When UF_6 is released into air, it immediately hydrolyzes to UO_2F_2 and HF. Although UO_2F_2 is a solid, it forms as an aerosol. The main HEPA filters are credited with reducing the quantity of uranium that may be released through the stack should there be a UF_6 release in the facility. As such, the integrity and efficiency of the HEPA filters in the main filter bank(s) are credited features of the CVS. The differential pressure across the active HEPA filter banks is monitored daily as a measure of the integrity of the HEPA filters. The efficiency is checked by an annual leak/efficiency test per American Society of Mechanical Engineers (ASME)/American National Standards Institute (ANSI) N510 to have an efficiency of 99% or greater. The differential pressure across the HEPA filters is acceptable in the range 0.2 in. w.g. to 4.0 in. w.g. The filters in the main bank were installed in 2003 and the fuel disposition project for which they are credited will be completed in 2008. Dry filters have a recommended service life of 10 years; therefore, there is no concern with respect to the length of service limit for these filters. It should be noted that, even though the HEPA filters are credited in the TSR, no specific reduction in consequences due to the presence of the filters is taken in the Documented Safety Analysis (DSA) or DSA Addendum.

Since the CVS is credited as a mitigative measure to a release, there is no requirement for the system to automatically recover from upset conditions such as power loss. When the CVS is not operable, the process system will be placed in or remain in a status which reduces the potential for a release of hazardous gases. In this status, compressed gas sources will be isolated and recycle pumps will be shut down so that there is no driver for a release. If a CVS alarm occurs, the facility workers evacuate the process areas and re-enter to secure the process system (e.g., close gas bottle valves) under strict surveillance and in accordance with an approved re-entry plan. The plan for restoration of the CVS may be as simple as switching to the stand-by stack fan.

The MSRE CVS might survive a PC-2 earthquake or a design tornado or wind event. However, this is a legacy facility that was adapted from one type reactor to another in the 1960's and its original design criteria were not the same as those currently used. An evaluation of the major process building was conducted and confirmed that the building would survive a PC-2 earthquake. This evaluation supports the premise that much of the CVS would survive a seismic event. However, there is no certification that the CVS would maintain its function following either a seismic or wind event and the MSRE Safety Basis does not take credit for the CVS in such event scenarios.

Most of the inlets to the CVS are equipped with some type of filtration. The major exception is the shielded cells. In normal operations, the shielding on these cells is in place and minimal air flow occurs through these spaces. The major building inlet air is filtered, but there are numerous penetrations in the walls that allow unfiltered air to enter the building. The exhaust ducts in the main process area (high bay) are filtered with commercial roughing filters. The following CVS enclosures are equipped with inlet and outlet HEPA filters: RGRS glovebox, utility hood, probe glovebox, hose connection glovebox, and cabinet M. The sampler/enricher box also has a HEPA exhaust filter. The HF cabinet and passivation cabinet are equipped with roughing inlet filters but no HEPA filters. Process boundary valves are enclosed in boxes with inlet HEPA filters. The interconnecting piping is enclosed in neoprene impregnated, wire reinforced, fiberglass ductwork. This ductwork exhausts through the six-valve manifold box and then through an exhaust HEPA filter into the main CVS header. The ducts supply the inlet air to the six-valve manifold box to sweep away any release within this enclosure. The CVS is not credited with mitigating releases of process gas from the process lines enclosed in the fiberglass ductwork.

The MSRE CVS is a manually operated system. The system is balanced and all enclosures are set to meet their required pressure differential. As inlet/outlet filters load, a damper may be adjusted to maintain the required differential pressure in the affected enclosure. Preventative maintenance on the filters ensures they are changed before they challenge the differential pressure limits in the Safety Basis. Baffles can also be manipulated to compensate for loading on the main filter banks. Again, preventative maintenance ensures the filters are changed out to correct loading on the main filters.

The CVS is credited for removal of hazardous gas releases in the eight specified enclosures in the MSRE FSD process systems. The CVS enclosures are safety significant System, Structure, and Components (SSCs) and designated as Design Features. The stack is also a Design Feature. The LCO (3.1.1) requires specific differential pressures be maintained for the credited enclosures. The LCO also requires the main HEPA filter banks to (a) be maintained in a specified range of differential pressure, (b) be tested for particle retention efficiency annually, and (c) be maintained in a configuration where at least one HEPA filter bank is in service for FSD operations in which UF_6 could be released. The stack fans and motors, including the motor starters, are considered Configured Items and serve as Defense-in-Depth controls. The remainder of the system (e.g., cell ventilation, ductwork, internal system filters, baffles, etc.) are not considered safety significant SSCs. Once the uranium is removed from the facility (scheduled to be completed in 2008) the CVS will no longer be a safety significant system.

1.3 MAJOR MODIFICATIONS

There are no major modifications planned for this facility at this time. However, once the fuel is removed from the salts, the CVS will no longer serve as a safety significant SSC.

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2. FUNCTIONAL CLASSIFICATION ASSESSMENT

2.1 EXISTING CLASSIFICATION

The MSRE CVS is currently classified as a safety significant system in the DSA. Once the uranium and hazardous gases are removed from the facility (estimated to occur in 2008), the CVS will no longer be considered a safety significant system.

2.2 EVALUATION

The MSRE CVS was evaluated per Deliverable 8.5.4 and 8.7 of the Implementation Plan for Defense Nuclear Facilities Safety Board (DNFSB) 2004-2, *Ventilation System Evaluation Guidance for Safety-Related and Non-Safety –Related Systems*. Table 4-3 from the guidance document has been completed to provide the information collected for the classification review and is attached in Appendix A.

The determination of bounding unmitigated consequences presented in the DSA was reviewed by the Facility Evaluation Team (FET). The review concluded that the quantitative dose consequences are determined in accordance with U.S. Department of Energy (DOE)-Standard (STD)-3009-94 and do not challenge the evaluation guideline for the public and co-located workers.

The MSRE CVS is identified in the MSRE Safety Basis Documents as a safety significant system which is credited with reducing the consequences to facility workers during hazardous gas releases. Specific performance criteria include maintaining differential pressures within the credited enclosures and across HEPA filters in the main filter pit. Quantitative filtering efficiency criteria are also credited in the TSR. HEPA filter efficiency testing is based on ASME/ANSI N510, Section 10 per Oak Ridge National Laboratory procedure FD-T-SSI 150, Rev 0. The controls associated with the MSRE CVS are part of a suite of controls designed to limit the exposure of facility workers to the hazardous process gases involved in the removal of fuel from the stored salts.

2.3 SUMMARY

The FET concluded that the MSRE CVS is appropriately classified as safety significant for specified FSD processes and mitigative measures.

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3. SYSTEM EVALUATION

3.1 IDENTIFICATION OF GAPS

The MSRE CVS 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 to provide the system evaluation, and is attached as Appendix B. The following gaps were identified:

- CVS does not maintain its integrity for Design Basis Accident (DBA) fire and natural phenomena hazards (NPH), and
- CVS controls are not fail-safe.

Based on the DSA, the CVS is a safety significant system which is credited for reducing event consequences for certain potential facility worker exposures. The criteria identified as gaps were not considered by the FET to be necessary for the MSRE CVS to perform the credited mitigative function. This conclusion is consistent with the requirements in the MSRE Safety Basis.

3.2 GAP EVALUATION

3.2.1 CVS does not maintain its integrity for all DBAs

The integrity of the CVS cannot be certified for design basis NPH such as earthquakes and tornados. In addition, the CVS would not survive an unmitigated DBA major facility fire. The CVS is not credited by the Safety Basis to perform any mitigative function for these types of events. The safety of facility workers is based on prompt evacuation of the process area during these NPH and fire events. Given the requirements from the MSRE Safety Basis, the identified gap is determined to be acceptable.

3.2.2 Controls are not fail-safe

The CVS is a manually operated system in that the fans and baffles are manually operated and have no automatic response to events. The system strategy is based on the mitigative function of the system for potential accidents. The system is designed to remain operating if there is a release of hazardous gas in the facility. There is no event in the MSRE Safety Basis that takes credit for the CVS when a concurrent CVS failure and release is involved (e.g., earthquake). The MSRE Safety Basis specifically addresses CVS failures during operations. The TSR requires that access to the affected area is controlled immediately, and the system is restored within 8 hours. If restoring the system cannot be achieved in the prescribed time, then all reagent gas feed valves must be closed, uranium transfers suspended, and the affected process placed in a mode where the CVS is not required. These requirements meet the intent of a fail-safe system. Given the requirements from the MSRE Safety Basis, the identified gap is determined to be acceptable.

3.3 MODIFICATIONS AND UPGRADES

No modifications are recommended to the MSRE CVS at this time. The criteria that are not met are not considered to be necessary for the MSRE CVS to perform the credited mitigative function based on the DSA requirements. The processes for which the CVS is required to be operable will be completed in 2008 and subsequently the CVS will no longer require safety significant status.

4. CONCLUSION

In conclusion, the MSRE CVS is managed as a safety significant system. The CVS is credited for reducing the consequences to facility workers from hazardous gas releases. While there are two gaps identified from the ventilation evaluation criteria comparison, the associated criteria were not considered necessary to meet the requirements in the MSRE Safety Basis and there are no increased consequences associated with these issues.

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5. REFERENCES

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

DSA-OR-7503-0007, *Documented Safety Analysis for the Molten Salt Reactor Experiment Facility, Oak Ridge National Laboratory, Oak Ridge Tennessee*

DSA-OR-7503-0007/A1, *Addendum to Documented Safety Analysis for the Molten Salt Reactor Experiment Facility, Oak Ridge National Laboratory, Oak Ridge Tennessee – Fuel Salt Operations*

TSR-OR-MSRE-0008, *Technical Safety Requirements for the Molten Salt Reactor Experiment Facility, Oak Ridge National Laboratory, Oak Ridge Tennessee*

FD-T-SSI 150, *Inspection and Testing of HEPA Filtered Systems (UT/B)*

BJC/OR-1494, *Facility 7503 Containment Ventilation System Description*

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APPENDIX A

Table 4-3 Data Collection Table
Confinement Documented Safety Analysis Information

Facility: <u>Molten Salt Reactor Experiment</u>			Hazard Category 2				Performance Expectations			
Bounding Accidents	**Type Confinement**		**Doses Bounding unmitigated/ mitigated**	**Confinement Classification**			**Function**	**Functional Requirements**	***Performance Criteria***	**Compensatory Measures**
	Active	**Passive**		**SC**	**SS**	**DID**				
DSA Addendum - Loss of Confinement events involving F_2, HF, and recirculation supply/exhaust line failures during Fluorination and Hydrofluorination Processes inside a secondary enclosure (Bounding Events F-6, F-15, F-16, HF-4, HF-4a) *All events except F-15 have chemical consequences only.)*	X		<u>Unmitigated</u> Public - 11.0 rem Collocated Worker - >25 rem but <100 rem <u>Mitigated</u> Public - <<1 rem Collocated Worker - <25 rem		X		Confinement for public protection Confinement for collocated worker protection In-facility worker protection	Maintain the process system confinement for events involving the failure of single containment pipes within secondary enclosures.	• Provide a differential pressure in the enclosures that contain single confinement barrier piping (greater than or equal to 0.15 in. water vacuum, except for the passivation and HF cabinets; which shall indicate greater than or equal to 0.4 in. water vacuum) • Accommodate any evaluated release in the respective enclosure without losing overall vacuum • Exhaust released material to the atmosphere via the exhaust stack through an in-service HEPA Filter Bank. • HEPA filters are credited with filtering 99% of the released radioactive particulates; thereby preventing significant radiological consequences to the public and the co-located worker • HEPA Filter Bank is maintained greater than or equal to 0.2 in. w.g., and less than or equal to 4.0 in. w.g. • All in-service HEPA Filter Banks are required to be Operable.	None

Table 4-3 Data Collection Table Confinement Documented Safety Analysis Information										
Facility: Molten Salt Reactor Experiment			**Hazard Category 2**				**Performance Expectations**			
Bounding Accidents	**Type Confinement**		**Doses Bounding unmitigated/ mitigated**	**Confinement Classification**			**Function**	**Functional Requirements**	**Performance Criteria**	**Compensatory Measures**
	Active	**Passive**		**SC**	**SS**	**DID**				
DSA Addendum - Loss of Confinement events involving tank failures such as the Fuel Flush Tank (Bounding Event F-2)	X		Unmitigated Public - 7.5 rem Collocated Worker - >25 rem but <100 rem Mitigated Public <<1 rem Collocated Worker - <25 rem The mitigated consequences are achieved by a pressure relief valve in conjunction with the CVS. The CVS only mitigates releases in a secondary enclosure.		X		Confinement for public protection (via filters and stack) Confinement for collocated worker protection (via filters and stack) In-facility worker protection (via enclosures and air flow)	Maintain the process system confinement for events involving the failure of single containment pipes within secondary enclosures.	• Provide a differential pressure in the enclosures that contain single confinement barrier piping (greater than or equal to 0.15 in. water vacuum, except for the passivation and HF cabinets; which shall indicate greater than or equal to 0.4 in. water vacuum) • Accommodate any evaluated release in the respective enclosure without losing overall vacuum • Exhaust released material to the atmosphere via the exhaust stack through an in-service HEPA Filter Bank. • HEPA filters are credited with filtering 99% of the released radioactive particulates; thereby preventing significant radiological consequences to the public and the co-located worker • HEPA Filter Bank is maintained greater than or equal to 0.2 in. w.g., and less than or equal to 4.0 in. w.g. • All in-service HEPA Filter Banks are required to be Operable.	None

Table 4-3 Data Collection Table

Confinement Documented Safety Analysis Information

Facility: Molten Salt Reactor Experiment			Hazard Category 2				Performance Expectations			
Bounding Accidents	Type Confinement		Doses Bounding unmitigated/ mitigated	Confinement Classification			Function	Functional Requirements	Performance Criteria	Compensatory Measures
	Active	Passive		SC	SS	DID				
DSA Addendum - Loss of Confinement events involving failure of the Cold Traps due to coolant system overpressure (Bounding Event F-17)	X		Unmitigated Public - 11.0 rem Collocated Worker - >25 rem but <100 rem Mitigated Public <<1 rem Collocated Worker - <25 rem The mitigated consequences are achieved by pressure relief valves in conjunction with the CVS. The CVS only mitigates releases in a secondary enclosure.		X		Confinement for public protection (via filters and stack) Confinement for collocated worker protection (via filters and stack) In-facility worker protection (via enclosures and air flow)	Maintain the process system confinement for events involving the failure of single containment pipes within secondary enclosures.	• Provide a differential pressure in the enclosures that contain single confinement barrier piping (greater than or equal to 0.15 in. water vacuum, except for the passivation and HF cabinets; which shall indicate greater than or equal to 0.4 in. water vacuum) • Accommodate any evaluated release in the respective enclosure without losing overall vacuum • Exhaust released material to the atmosphere via the exhaust stack through an in-service HEPA Filter Bank. • HEPA filters are credited with filtering 99% of the released radioactive particulates; thereby preventing significant radiological consequences to the public and the co-located worker • HEPA Filter Bank is maintained greater than or equal to 0.2 in. w.g., and less than or equal to 4.0 in. w.g. • All in-service HEPA Filter Banks are required to be Operable.	None

Table 4-3 Data Collection Table
Confinement Documented Safety Analysis Information

Facility: Molten Salt Reactor Experiment			Hazard Category 2				Performance Expectations			
Bounding Accidents	Type Confinement		Doses Bounding unmitigated/ mitigated	Confinement Classification			Function	Functional Requirements	Performance Criteria	Compensatory Measures
	Active	Passive		SC	SS	DID				
DSA Addendum - Loss of Confinement events involving transfer line failures during the Sublimation Process (Bounding Events SUB-3, SUB-3a, and SUB-11)	X		Unmitigated Public 4.7 rem Collocated Worker - >25 rem but <100 rem Mitigated Public - <<1 rem Collocated Worker - <25 rem The mitigated consequences are achieved by pressure relief valves and an emergency shutdown system in conjunction with the CVS. The CVS only mitigates releases in a secondary enclosure.		X		Confinement for public protection (via filters and stack) Confinement for collocated worker protection (via filters and stack) In-facility worker protection (via enclosures and air flow)	Maintain the process system confinement for events involving the failure of single containment pipes within secondary enclosures.	• Provide a differential pressure in the enclosures that contain single confinement barrier piping (greater than or equal to 0.15 in. water vacuum, except for the passivation and HF cabinets; which shall indicate greater than or equal to 0.4 in. water vacuum) • Accommodate any evaluated release in the respective enclosure without losing overall vacuum • Exhaust released material to the atmosphere via the exhaust stack through an in-service HEPA Filter Bank. • HEPA filters are credited with filtering 99% of the released radioactive particulates, thereby preventing significant radiological consequences to the public and the co-located worker • HEPA Filter Bank is maintained greater than or equal to 0.2 in. w.g., and less than or equal to 4.0 in. w.g. • All in-service HEPA Filter Banks are required to be Operable.	None

Table 4-3 Data Collection Table
Confinement Documented Safety Analysis Information

Facility: Molten Salt Reactor Experiment			Hazard Category 2				Performance Expectations			
Bounding Accidents	**Type Confinement**		**Doses Bounding unmitigated/ mitigated**	**Confinement Classification**			**Function**	**Functional Requirements**	**Performance Criteria**	**Compensatory Measures**
	Active	**Passive**		**SC**	**SS**	**DID**				
DSA Addendum - Loss of Confinement events involving excess UF_6 fed to the NaF trap and bypass of the NaF trap (Bounding Events SUB-7 and SUB-7a)	X		Unmitigated Public 4.7 rem Collocated Worker - >25 rem but <100 rem Mitigated Public - <<1 rem Collocated Worker - <25 rem The mitigated consequences are achieved by NDA systems, bypass valves, and mass flow controllers in conjunction with the CVS. The CVS only mitigates releases in a secondary enclosure.		X		Confinement for public protection (via filters and stack) Confinement for collocated worker protection (via filters and stack) In-facility worker protection (via enclosures and air flow)	Maintain the process system confinement for events involving the failure of single containment pipes within secondary enclosures.	• Provide a differential pressure in the enclosures that contain single confinement barrier piping (greater than or equal to 0.15 in. water vacuum, except for the passivation and HF cabinets; which shall indicate greater than or equal to 0.4 in. water vacuum) • Accommodate any evaluated release in the respective enclosure without losing overall vacuum • Exhaust released material to the atmosphere via the exhaust stack through an in-service HEPA Filter Bank. • HEPA filters are credited with filtering 99% of the released radioactive particulates; thereby preventing significant radiological consequences to the public and the co-located worker • HEPA Filter Bank is maintained greater than or equal to 0.2 in. w.g., and less than or equal to 4.0 in. w.g. • All in-service HEPA Filter Banks are required to be Operable.	None

Table 4-3 Data Collection Table
Confinement Documented Safety Analysis Information

Facility: Molten Salt Reactor Experiment			Hazard Category 2				Performance Expectations			
Bounding Accidents	Type Confinement		Doses Bounding unmitigated/ mitigated	Confinement Classification			Function	Functional Requirements	Performance Criteria	Compensatory Measures
	Active	Passive		SC	SS	DID				
DSA Addendum - Loss of Confinement events during tanks heating (Bounding Events TH-4, TH-4a, and TH-7)	X		Negligible unmitigated to the public and collocated workers.			X	In-facility worker protection (via enclosures and air flow)	Maintain the process system confinement for events involving the failure of single containment pipes within secondary enclosures.	• Provide a differential pressure in the enclosures that contain single confinement barrier piping (greater than or equal to 0.15 in. water vacuum, except for the passivation and HF cabinets; which shall indicate greater than or equal to 0.4 in. water vacuum) • Accommodate any evaluated release in the respective enclosure without losing overall vacuum • Exhaust released material to the atmosphere via the exhaust stack through an in-service HEPA Filter Bank. • HEPA filters are credited with filtering 99% of the released radioactive particulates; thereby preventing significant radiological consequences to the public and the co-located worker • HEPA Filter Bank is maintained greater than or equal to 0.2 in. w.g., and less than or equal to 4.0 in. w.g. • All in-service HEPA Filter Banks are required to be Operable.	None

Table 4-3 Data Collection Table

Confinement Documented Safety Analysis Information

Facility: Molten Salt Reactor Experiment			**Hazard Category 2**				**Performance Expectations**			
Bounding Accidents	**Type Confinement**		**Doses Bounding unmitigated/ mitigated**	**Confinement Classification**			**Function**	**Functional Requirements**	**Performance Criteria**	**Compensatory Measures**
	Active	**Passive**		**SC**	**SS**	**DID**				
DSA - Loss of Confinement events involving F_2 or ClF_3 supply/relief line failures, and NaF Trap breakthrough or bypass to the CVS (Bounding Events TG-1, TG-3, TG-6, RG-8, RG-9)	X		Negligible unmitigated radiological consequences to the public and collocated workers. The CVS is credited for chemical consequences during Surveillance and Maintenance.			X	In-facility worker protection (via enclosures and air flow)	Maintain the process system confinement for events involving the failure of single containment pipes within secondary enclosures.	• Provide a differential pressure in the enclosures that contain single confinement barrier piping (greater than or equal to 0.15 in. water vacuum, except for the passivation and HF cabinets; which shall indicate greater than or equal to 0.4 in. water vacuum) • Accommodate any evaluated release in the respective enclosure without losing overall vacuum • Exhaust released material to the atmosphere via the exhaust stack through an in-service HEPA Filter Bank. • HEPA filters are credited with filtering 99% of the released radioactive particulates; thereby preventing significant radiological consequences to the public and the co-located worker • HEPA Filter Bank is maintained greater than or equal to 0.2 in. w.g., and less than or equal to 4.0 in. w.g. • All in-service HEPA Filter Banks are required to be Operable.	None

Justification for Safety Significant Designation of CVS versus Safety Class Designation

The CVS at the MSRE facility is credited with minimizing the consequences associated with the loss-of-confinement events that result in the release of reagent gases and/or UF_6. These loss-of-confinement accidents involve the failure of the single containment pipes within one of the secondary confinement enclosures (e.g., the passivation cabinet or HF cabinet). The CVS has not been credited for other types of events (e.g., fire or natural phenomena) and has not been designed or evaluated to survive PC-2 natural phenomena events. In addition, no credit is taken for the CVS stack or filters, except in cases where the accident is an inadvertent release through process equipment to the CVS (i.e., loss-of-confinement event).

The piping used to transfer UF_6 at the MSRE facility is of double-walled construction. The hazardous gases are transferred in the inner section of the piping and the outer annulus is pressurized with He gas. The annulus pressure in each section of piping is monitored with a pressure transmitter. Upon loss of pressure in the annulus, the pressure transmitter activates an automatic emergency shutdown of the transfer system. Failures of process piping or valves within secondary confinement enclosures (Cabinet M, Probe glovebox, Hose connection glovebox, 6 Valve manifold glovebox, Reactive Gas Removal System (RGRS) glovebox, Reactor Sample Enricher Box) are not automatically detected by the emergency shutdown system and will not result in automatic shutdown. The CVS exhaust mitigates worker exposure to the released gases inside an enclosure by maintaining airflow through the enclosure, to the MSRE stack. The required pressure differentials indicate a flow toward the CVS exhaust and sufficient vacuum to accommodate any release into these enclosures. A High-Efficiency Particulate Air (HEPA) filter system is provided to filter the aerosol uranium out of the CVS exhaust prior to being discharged to the atmosphere, thereby reducing exposure to the public and co-located workers.

The guidance provided by the DOE with respect to the CVS evaluation was provided in *Ventilation System Evaluation Guidance for Safety-Related and Non-Safety-Related Systems*. This guidance provides information and direction for completing the Data Collection Table shown previously. With respect to the classification of the CVS, the DOE guidance states that if the bounding unmitigated dose challenges the Evaluation Guidelines (i.e., is in the range of 1-25 rem) and the classification is not safety class, provide the rationale/justification in an attachment for the lesser classification. The unmitigated doses calculated in the DSA Addendum for MSRE range from 4.7 rem to 11.0 rem. These doses were determined utilizing calculations consistent with the requirements of DOE-STD-3009, utilizing dispersion parameters corresponding to 95% meteorology conditions for the Oak Ridge National Laboratory, and a Leak Path Factor of 1.0. The CVS in the DSA and DSA Addendum for MSRE is classified as a Safety Significant ventilation system. As such, this attachment is included to provide the rationale and justification for classifying the CVS at MSRE as Safety Significant instead of Safety Class. The events of interest in this classification are provided in the following discussion. The CVS stack and filters are not credited for a release of material into the High Bay or South Truck Bay that would not exhaust through the CVS.

Cold Trap and Line Failure Events F-15 and F-17

Event F-15 is a recirculation line failure inside a secondary enclosure. The release in the enclosure is vented by the CVS, through the HEPA filter and stack before being released to the environment. The confinement of the enclosure protects the facility worker, while the HEPA filter and release from the stack will dilute the release and protect the collocated worker and public. The analysis used for event F-15 is discussed in more detail in this section to demonstrate the conservative nature of the analysis that led to classifying the CVS as Safety Significant and not Safety Class. Event F-17 is an overpressure event that is prevented by the presence of a credited pressure relief valve. As such, the CVS does not serve as the primary line of defense for this event and does not warrant a Safety Class designation.

The maximum dose to the public for Event F-15 is estimated to be 11 rem. This dose is not considered to challenge the guideline when consideration is taken for the conservatism built into the analysis. F-15 is an event during the fluorination process when reagent gas is sparged into the salt. The 11 rem estimate is based on the assumption that UF_6 will continue to be generated at the same rate after the event occurs, even though the sparge gas is largely made up of air after the failure due to the recirculation pumps sucking air into the breached pipe. The F_2 that would normally be recycled is being removed through the RGRS. The F_2 make-up maximizes at 10 sL/m, thus reducing the F_2 in the input stream. In addition, moisture in the air may overcome the fluorination reaction and produce significant quantities of UO_2F_2, which will not volatilize as readily as UF_6. The assumption that the UO_2F_2 (solid) aerosol formed when UF_6 reacts with the water in air remains airborne to the site boundary is a conservative one. The uranium mass (611 g) assumed in the tank header at the time of the rupture is a conservative estimate of the maximum uranium content of the drain tank head space during the course of the process. While remaining consistent with the methodology of DOE-STD-3009, the assumptions discussed could result in a reduction of the dose by an order of magnitude. As such, the actual amount of material that would be released during this event is less than estimated and does not challenge the 25 rem criteria to the public.

Tank Failure Event F-2

Event F-2 is a tank failure (e.g., Fuel Flush Tank) during fluorination where the F_2 gas supply could drive the gases out of the tank into the cell or the High Bay. This event is mitigated by the emergency shutdown system if the breach is in a pipe between enclosures. The emergency shutdown system is invoked for worker protection and is protected in the TSR at the safety-significant level. A release in an enclosure is vented by the CVS, through the HEPA filter and stack before being released to the environment. The confinement of the enclosure protects the facility worker, while the HEPA filter and release from the stack will dilute the release and protect the collocated worker and public. The analysis used for event F-2 is discussed in more detail in this section to demonstrate the conservative nature of the analysis that led to classifying the CVS as Safety Significant and not Safety Class.

The maximum dose to the public for Event F-2 is estimated to be 7.5 rem. This dose is not considered to challenge the guideline when consideration is taken for the conservatism built into the analysis. F-2 is an event during the fluorination process when reagent gas is sparged into the salt. The 7.5 rem estimate is based on the assumption that UF_6 will continue to be generated at the same rate after the event occurs, even though the sparge gas is largely made up of air after the failure due to the recirculation pumps sucking air into the breached pipe. The F_2 that would normally be recycled is being removed through the RGRS. The F_2 make-up maximizes at 10 sL/m, thus reducing the F_2 in the input stream. In addition, moisture in the air may overcome the fluorination reaction and produce significant quantities of UO_2F_2, which will not volatilize as readily as UF_6. The assumption that the UO_2F_2 (solid) aerosol formed when UF_6 reacts with the water in air remains airborne to the site boundary is a conservative one. The uranium mass (500 g) assumed in the tank space of the flush tank at the time of the rupture is assumed to volatilize from the solid state. This assumption is a conservative estimate of the maximum uranium content of the drain tank head space during the course of the process. The 100 g U assumed in the tank header (at 15% conversion) at the time of the rupture is a conservative estimate of the maximum uranium content of the drain tank head space during the course of the process. The further assumption that, neglecting the aforementioned conversion to UO_2F_2, another 400 g U will be converted from the flush salt in a two-hour period is also conservative. While remaining consistent with the methodology of DOE-STD-3009, the assumptions discussed could result in a reduction of the dose by an order of magnitude. As such, the actual amount of material that would be released during this event is less than estimated and does not challenge the 25 rem criteria to the public.

Transfer Line Failure and Trap Failure Events SUB-3, SUB-3a, SUB-11, SUB-7, and SUB-7a

Events SUB-3, SUB-3a and SUB-11 involve transfer line failures during the sublimation process. The failure may occur in the line to the RGRS or a line in a secondary enclosure. Events SUB-7 and SUB-7a involve the breakthrough or bypass of the NaF traps releasing material to the RGRS. In the case of a simple line breach, SUB-3 and SUB-3a, the emergency shutdown system is invoked for worker protection and is protected in the TSR at the safety-significant level. This control limits the extent of the release and therefore also limits the dose to the public. Where the breach occurs within a CVS enclosure, event SUB-11, the CVS has been credited as a control for protecting the workers. This system, with its filters and stack, also provides a control limiting the dose to the collocated worker and public. Administratively locked-closed bypass valves and NDA detection instrumentation have been credited with preventing the release to on-site workers for those cases, SUB-7 and SUB-7a, in which a malfunction of the RGRS is considered. These controls also prevent the release to the public.

The analysis used for these 'SUB' events is discussed in more detail in this section to demonstrate the conservative nature of the analysis that led to classifying the CVS as Safety Significant and not Safety Class.

The maximum dose to the public for these events is estimated to be 4.7 rem. This dose is not considered to challenge the guideline when consideration is taken for the conservatism built into the analysis. The 4.7 rem dose is estimated assuming the sublimation rate is such that the gas flowing out of the Cold Trap is saturated with UF_6 (i.e., contains UF_6 at its equilibrium partial pressure at room temperature). This assumption is conservative given that the model used also indicates that when there is a breach and the pressure in the transfer line increases, (approximately one atmosphere following the breach) the rate of release of UF_6 reduces by as much as half. For those cases, SUB-7 and SUB-7a, in which there is no breach, but the release is through the RGRS to the CVS and out the stack, the off-site consequences are reduced by a factor of 5 due to the greater dispersion afforded by the elevated release. Loss of the stack would constitute an independent second failure of a system, and therefore an elevated release due to the presence of the stack is considered in an unmitigated case. While remaining consistent with the methodology of DOE-STD-3009, the assumptions discussed could result in a reduction of the dose by an order of magnitude. As such, the actual amount of material that would be released during this event is less than estimated and does not challenge the 25 rem criteria to the public.

APPENDIX B

Table 5-1 Ventilation System Performance Criteria – for MSRE CVS				
Evaluation Criteria	**Safety Significant**	**Evaluation Criteria Explained**	**System Capabilities and Characteristics**	**Reference**
Pressure differential should be maintained between zone and atmosphere.	Applies	Per DOE-HNDBK-1169, Table 2.1: • Primary: -0.3 to -1.0 in. w.g. • Secondary: -0.03 to -0.15 in. w.g. • Tertiary: -0.01 to -0.15 in. w.g. Section 2.3.1 states that system flow (and DPs) may be reduced during periods of non-operation.	The MSRE CVS is credited with maintaining a pressure differential (vacuum) in 8 confinement enclosures during fuel removal processes. Six of these enclosures must have a differential pressure with respect to the room (High Bay or South Truck Bay) of 0.15 in. w.g. or better and 2 of these enclosures must have a differential pressure of 0.4 in. w.g. or better. MSRE considers the process piping and vessels within the enclosures the primary containment. The enclosures are secondary containment and the tertiary containment is the building, which is at approximately -0.1 in. w.g. The building is not credited. The MSRE CVS meets the intent of the recommendation in that there is a pressure differential between confinement levels. However, MSRE does not meet the specific differential pressures recommendations from HNDBK-1169.	DOE-HDBK-1169 (2.2.9), ASHRAE Design Guide

Table 5-1 Ventilation System Performance Criteria – for MSRE CVS				
Evaluation Criteria	**Safety Significant**	**Evaluation Criteria Explained**	**System Capabilities and Characteristics**	**Reference**
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 MSRE CVS is a legacy system that was modified for use in the reactor experiment (1960's) and again modified for the FSD project (1995 to present). Construction specifications and/or drawings for the original "as built" system are not available. Some areas of the ductwork, such as the reactor vent, are not readily accessible for observation. All major ductwork appears to be steel construction, either welded or bolted with gaskets. Ductwork and enclosures expected to be exposed to corrosive atmospheres are composed of suitable resistant materials. Ductwork enclosing process piping from several remote areas of the facility exhausts through the 6-valve manifold enclosure and is constructed of neoprene impregnated, wire reinforced fiberglass. This ductwork could be exposed to a mildly corrosive atmosphere (e.g., F_2, HF, UF_6); however, the ductwork is not required to be resistant to process gases in the DOE approved 10 Code of Federal Regulations (CFR) 830 compliant facility safety basis documents. The MSRE CVS does not include an air treatment system. The only electronic components are those associated with the filter pit loss-of-vacuum alarm. These components are qualified for their intended application. In addition, the alarm is tested on a monthly basis. The MSRE CVS meets the intent of the recommendations in that suitable materials are employed at a level commensurate with their expected exposure.	DOE-HDBK-1169 (2.2.5), ASME AG-1

Table 5-1 Ventilation System Performance Criteria – for MSRE CVS				
Evaluation Criteria	**Safety Significant**	**Evaluation Criteria Explained**	**System Capabilities and Characteristics**	**Reference**

System should maintain confinement integrity during normal, abnormal, and accident conditions	Applies	Per DOE-HNDBK-1169, Section 2.4:
		• For all conditions and 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 system maintains confinement for all normal, abnormal, and accident conditions for which it is expected to remain functional. The CVS provides confinement and ventilation for credited accident conditions (process gas releases). The CVS components will withstand conditions associated with expected normal and abnormal operations. Provisions for power loss and fan failure are provided for by facility procedures which mandate any process involving hazardous material transfers be terminated if the CVS fails. These provisions reduce the quantity of gases that could potentially be released in an accident. The system is not expected to remain functional by the DOE approved facility safety basis to survive the worst DBA, a major fire affecting the High Bay. However, the CVS does remain functional for the loss of confinement events for which it is credited.
			
			The MSRE CVS meets the recommendations in that it maintains confinement integrity for all DBAs for which it is expected to remain functional.
				DOE-HDBK-1169 (2.4), ASHRAE Design Guide

System should have appropriate filtration to minimize release	Does Not Apply	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.	The MSRE CVS has no primary confinement zones. It is principally a secondary confinement system with some tertiary areas (process building itself). The system has HEPA filters in the main filter beds that are credited to capture some of the UO_2F_2 aerosol formed in a UF_6 release. The filters do not capture hazardous gases, HF and F_2. The main HEPA filters are tested annually. The system also has HEPA inlet filters on inlets that serve vented secondary enclosures in which there may be a UF_6 release. Filters on inlets to other secondary and tertiary enclosures (High Bay) are not HEPA filters. There are no filters on the inlets (penetration of the shielding) to the facility cells. The MSRE CVS does not have any primary confinement zones. The configuration remains consistent with the MSRE Safety Basis requirements.	DOE-HDBK-1169 (2.2.1), ASME AG-1

Table 5-1 Ventilation System Performance Criteria – for MSRE CVS				
Evaluation Criteria	**Safety Significant**	**Evaluation Criteria Explained**	**System Capabilities and Characteristics**	**Reference**
Provide system status instrumentation and/or alarms	Applies	Per DOE-HNDBK-1169, Section 2.4.2: • Visible and audible alarms should be provided, both locally and at a central control station, to signal the operator when a malfunction to the system has occurred. In addition, indicator lights to show the operational status of fans and controls in the system should be provided in the central control room.	The system is required to be operable during performance of specified processes. When these processes are in progress, all credited enclosure pressures are monitored daily. There is an alarm on the vacuum at the filter pit to warn the operators if a failure of the system (i.e., loss of stack fan) occurs. This alarm is audible throughout the facility and at an off-site location. The alarm is also indicated visually on the control room monitor. The MSRE CVS meets the intent of the recommendations in that a visible and audible alarm is activated on gross failure of the system.	DOE-HDBK-1169, ASHRAE Design Guide (Section 4), ASME AG-1
Interlock supply and exhaust fans to prevent positive pressure differential	Does Not Apply	No explanation required.	The MSRE CVS has no supply fans. The exhaust fans are located such that they do not generate a potential for a positive pressure differential in the process system.	DOE-HDBK-1169 ASHRAE Design Guide (Section 4)
Post-accident indication of filter break-through	Applies	While the reference does discuss post-accident monitoring, it does not discuss post-accident indication of filter break-through.	The differential pressure across the filter banks is an available indication of filter break-through. This system parameter is monitored daily and following any abnormal occurrence involving the CVS. The MSRE CVS meets this recommendation by monitoring of the pressure differential across the filters.	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 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 controls consist of the stack fan motor electrical supply and switches. The switchgear and relay components are located in a remote separate building where they would not be affected by either normal exposure or DBAs. The system is subject to loss of power to the facility, but the system is not credited to be operational under this condition.
			
			The MSRE CVS meets the intent of this recommendation in that the control system is not affected by DBAs and the system is not expected to remain functional during power failures or fan failures. Critical components such as fans are redundant in the MSRE CVS.
				DOE-HDBK-1169 (2.4)

Table 5-1 Ventilation System Performance Criteria – for MSRE CVS				
Evaluation Criteria	**Safety Significant**	**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)	The MSRE CVS is not required by the DOE approved facility safety basis documents to shut down in an emergency or automatically close any dampers to protect the filters. The system is designed to remain operating if there is a release of hazardous gas in the facility. The CVS is not credited to mitigate an earthquake or fire event at the MSRE facility. A failure in the CVS system itself, usually a fan failure, does not require a change in the damper configuration since its mitigative function applies only when there is a release to the system. There is no event for which the CVS is credited that would cause a concurrent CVS failure and release. If the CVS fails, any process in progress is terminated so no significant subsequent release is anticipated. The MSRE CVS does not meet this recommendation and the criteria is not required by the DOE approved DSA/TSR.	DOE-HDBK-1169 (2.4)

Table 5-1 Ventilation System Performance Criteria – for MSRE CVS

Evaluation Criteria	Safety Significant	Evaluation Criteria Explained	System Capabilities and Characteristics	Reference
System should withstand credible fire events and be available to operate and maintain confinement	Applies	Per DOE-HNDBK-1169, Section 10.6: • The ventilation system filter housing construction materials should be noncombustible. • Process hazards inside and outside the ventilation filter housings should be controlled • General area sprinklers 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.	The MSRE CVS is not credited to survive a worst case DBA fire event. The worst-case fire event would have a duration of such length that facility workers have ample time to evacuate before the CVS would be significantly affected. The CVS is not credited to protect workers at nearby facilities or the public. The system filter housing is constructed of noncombustible material (concrete filter beds). Sprinklers within the process areas are not credited. The final filter housing is separated by distance from the process building. There are no fire preventative or retardant measures at the filter pits. The final filters are not alarmed for a fire event or otherwise protected from such an event other than being separated from the process building and housed in construction materials that will not sustain a fire. The MSRE CVS within the process building would not survive the DBA fire event. The final filters are protected from most fire events. The system does not meet all the recommendations. The MSRE CVS is not required to meet these requirements by the DOE approved safety basis documents.	DOE-HDBK-1169 (10.1), DOE-STD-1066

Table 5-1 Ventilation System Performance Criteria – for MSRE CVS				
Evaluation Criteria	**Safety Significant**	**Evaluation Criteria Explained**	**System Capabilities and Characteristics**	**Reference**
System should not propagate spread of fire	Applies	DOE-HNDBK-1169, Section 10 states: • The accumulation of dust and debris inside the air cleaning system ductwork over long periods of operation provides a mechanism for transporting flames from an ignition source to the filters. (Section 10.5.2.2) • Air cleaning systems should not cross fire area boundaries (Section 10.6.2.2) • Ducts penetrating fire rated barriers should be insulated or enclosed as determined by the FHA (Section 10.6.2.2) • The preferred construction materials for ductwork are steel, stainless steel, or galvanized steel. If fiberglass ductwork is needed, special ductwork meeting the flame-spread criteria in NFPA 90A is required. (Section 10.6.2.2) • Filter casings of wood construction requires a fire retardant treatment that results in a flame spread of 25 or less when tested by ASTM E-84. (Section 10.6.2.2)	The CVS is not a factor in propagating the DBA fire event. The worst-case DBA fire event is initiated outside the process area and must endure for some time before the process area is seriously affected. By the time the CVS is affected by the fire, any contribution from its components would be negligible in sustaining the fire. Combustible loading in the process areas is maintained at a level that any fire initiated in these areas would burn out before it would damage process equipment, including the components of the CVS system (with the possible exception of the aforementioned fiberglass-covered ductwork). The credited parts of the CVS are constructed of fire resistant material (principally steel) and would not contribute to propagation of a fire. No other fire protection measures are imposed on the system. The MSRE CVS meets the intent of the requirement in that any contribution from its components would be negligible in sustaining the fire. However, it does not have the specific fire protection measures recommended, other than materials of construction. These fire protection measures and other specific recommendations are not applicable to the MSRE system because they are not required by the safety basis documents.	DOE-HDBK-1169 (10.1), DOE STD 1066

Table 5-1 Ventilation System Performance Criteria – for MSRE CVS				
Evaluation Criteria	**Safety Significant**	**Evaluation Criteria Explained**	**System Capabilities and Characteristics**	**Reference**
System should safely withstand earthquakes	Applies	Per DOE-HNDBK-1169, Section 2.6: • At nuclear facilities, buildings and equipment designated Safety Class or Safety Significant are specifically designed to withstand the effects of a design basis earthquake (DBE). Per DOE-HNDBK-1169, Section 5.6.5: • Instruments used in safety-related systems must be qualified for seismic conditions per ASME AG-1, Section IA. Per DOE-HNDBK-1169, Section 9.2.2: • The DBE for the performance category (PC) of the system should be determined from Table 9.1. External components of the system (e.g. housings, fans, etc.) should be rigidly anchored to major building elements (walls, floors, partitions). The components should perform their intended functions and, if required by procurement specs, should not sustain damage during or after they are subjected to excitations resulting from ground motions due to the DBE. This seismic qualification may be achieved following any one or a combination of analysis, testing, and experience based data.	The MSRE CVS may not withstand a DBA (PC-2) earthquake. Many of the CVS components were constructed to older requirements that may not be applicable today. The facility process building structure has been certified for a PC-2 event, which would protect a good portion of the CVS system. However, there is no requirement in the safety basis to maintain the CVS through such an event. The MSRE CVS does not meet the recommendation; however, the recommendation is not required by the MSRE safety basis documents.	DOE-HDBK-1169 (9.2), DOE O420.1B, ASME AG-1 AA

Table 5-1 Ventilation System Performance Criteria – for MSRE CVS

Evaluation Criteria	Safety Significant	Evaluation Criteria Explained	System Capabilities and Characteristics	Reference
System should safely withstand tornado depressurization	Applies	Per DOE-HNDBK-1169, Section 5.6.5: • Instruments used in safety-related systems must be qualified for environmental conditions per ASME AG-1, Section IA. Per DOE-HNDBK-1169, Section 9.2.4: • Wind design criteria for a tornado for the performance criteria (PC) of the system should be determined from Table 9.2. Only systems designed based on PC-3 and PC-4 are required to meet the tornado design criteria. Evaluation of existing systems should focus on the strengths of connections and anchorages as well as the ability of the wind loads to find a continuous path to the foundation or support system. All obvious damage sequences should be examined for progressive failures. Once the failure sequences are identified, the system performance is compared with the stated performance goals for the specified PC. See Appendix D of DOE-STD-1020 for more information.	The MSRE CVS may not withstand a DBA tornado. Many of the CVS components were constructed to older requirements that may not be applicable today. The facility process building structure has been certified for a PC-2 event, which would protect a good portion of the CVS system. However, there is no requirement in the safety basis to maintain the CVS through such an event. The MSRE CVS does not meet the recommendation; however, the recommendation is not required by the MSRE safety basis documents.	DOE-HDBK-1169 (9.2), DOE O420.1B

Table 5-1 Ventilation System Performance Criteria – for MSRE CVS				
Evaluation Criteria	**Safety Significant**	**Evaluation Criteria Explained**	**System Capabilities and Characteristics**	**Reference**
System should withstand design wind effects on system performance	Applies	Per DOE-HNDBK-1169, Section 5.6.5: • Instruments used in safety-related systems must be qualified for environmental conditions per ASME AG-1, Section IA. Per DOE-HNDBK-1169, Section 9.2.4: • Wind design criteria for a tornado for the performance criteria (PC) of the system should be determined from Table 9.2. Only systems designed based on PC-3 and PC-4 are required to meet the tornado design criteria. Evaluation of existing systems should focus on the strengths of connections and anchorages as well as the ability of the wind loads to find a continuous path to the foundation or support system. All obvious damage sequences should be examined for progressive failures. Once the failure sequences are identified, the system performance is compared with the stated performance goals for the specified PC. See Appendix D of DOE-STD-1020 for more information.	The MSRE CVS may not withstand a DBA wind event. Many of the components were constructed to older requirements that may not be applicable today. The facility process building structure has been certified for a PC-2 event, which would protect a good portion of the CVS system. However, there is no requirement in the safety basis to maintain the CVS through such an event. The MSRE CVS does not meet the recommendation; however, the recommendation is not required by the MSRE safety basis documents.	DOE-HDBK-1169 (9.2), DOE O420.1B
System should withstand other natural phenomenon events considered credible in the DSA where system is credited	Applies	Per DOE-HNDBK-1169, Section 5.6.5: • Instruments used in safety-related systems must be qualified for environmental conditions per ASME AG-1, Section IA. Per DOE-HNDBK-1169, Section 9.2.1: • Evaluate the system based on DOE-STD-1020. The overall DOE NPH design input, as well as applicable DOE Orders and standards are shown in Figure 9.1.	The MSRE CVS may not withstand other natural phenomena events. Many of the components were constructed to older requirements that may not be applicable today. The facility process building structure has been certified for a PC-2 event, which would protect a good portion of the CVS system. However, there is no requirement in the safety basis to maintain the CVS through such an event. The MSRE CVS does not meet the recommendation; however, the recommendation is not required by the MSRE safety basis documents.	DOE-HDBK-1169 (9.2), DOE O420.1B

Table 5-1 Ventilation System Performance Criteria – for MSRE CVS

Evaluation Criteria	Safety Significant	Evaluation Criteria Explained	System Capabilities and Characteristics	Reference
Administrative controls to protect system from barrier-threatening events	Applies	DOE O420.1B Chapter I Section 3.b(2)(f) states: • Systems must include administrative controls to monitor facility conditions during and after an event. DOE O420.1B pg 8 states: • See DOE-STD-1186-2004, Specific Administrative Controls.	Administrative controls protect the CVS from a fire event through requirements such as combustible loading controls. Following an accident or failure of the CVS, administrative controls protect facility components and workers by terminating hazardous processes and prevent startup of processing activities until the CVS operability at the required level is ensured. The MSRE CVS meets the intent of the recommendation.	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.	A leak test on the CVS HEPA Filter Bank is conducted annually to VERIFY the efficiency is greater than or equal to 99% for particulates as defined by ASME/ANSI N510, Section 10 per Oak Ridge National Laboratory procedure FD-T-SSI 150, Rev. 0. The differential pressure across the in-service HEPA filter banks is monitored daily. Access to all components of the filter housing, instrumentation, fan, and controls for operation, maintenance, and testing is unencumbered. The MSRE CVS meets the recommendation.	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.	All pressure gauges on credited vented enclosures and credited instruments (e.g., pressure switches) at the filter banks are calibrated annually. The MSRE CVS meets the recommendation.	DOE-HDBK-1169 (2.3.8)
Integrated system performance testing is specified and performed	Applies	Per DOE-HNDBK-1169, Section 2.3.8: • Air cleaning systems designed in accordance with ASME AG-1 should be tested in accordance with ASME AG-1, Section TA. Those systems designed to ASME N509 or still covered by its 2002 maintenance revision, should be tested in accordance with the provisions of ASME N510. Other older systems not designed to either ASME AG-1 or N509 are generally tested by following the guidance in ASME N510.	The filter pit vacuum alarm is subject to a functional test annually. The functional test ensures that the low pressure alarm activates when the system pressure is equal to or greater than 1.0 inches water vacuum. The alarm annunciator is tested for audibility monthly to ensure the alarm is audible above background in the affected areas and all associated access doors. A leak test on the CVS HEPA Filter Bank is also conducted annually to VERIFY the efficiency is greater than or equal to 99% for particulates as defined by ASME/ANSI N510, Section 10 per Oak Ridge National Laboratory procedure FD-T-SSI 150, Rev. 0. These tests are required by the MSRE Safety Basis. The MSRE CVS meets the recommendation.	DOE-HDBK-1169 (2.3.8)

Table 5-1 Ventilation System Performance Criteria – for MSRE CVS				
Evaluation Criteria	**Safety Significant**	**Evaluation Criteria Explained**	**System Capabilities and Characteristics**	**Reference**
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.	The FSD project at MSRE is scheduled to be completed within 10 years of the last change-out of filters in the filter banks. The CVS will not be a "credited" system following removal of the fuel from the three fuel drain tanks. Until that time, the filters are to be replaced if they fail the annual leak test as specified in the TSR or if the differential pressure approaches the limits of the TSR specified range. The CVS meets the intent of the recommendation.	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.)	Not applicable. Not a Safety Class system.	DOE O420.1B, Chapter I, Sec. 3.b(8)
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.	Emergency electrical power is not required by the safety basis documents for the CVS.	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.	Emergency electrical power is not required by the safety basis documents for the CVS.	DOE-HDBK-1169 (2.2.7)

Table 5-1 Ventilation System Performance Criteria – for MSRE CVS				
Evaluation Criteria	**Safety Significant**	**Evaluation Criteria Explained**	**System Capabilities and Characteristics**	**Reference**
Other specific functional requirements credited in the DSA	Applies	TSR-OR-MSRE-0008, LCO 3.1.1, Maintenance of a specified differential pressure in each credited confinement vented enclosure during fuel removal processes.	Differential pressure gauges on credited enclosures are calibrated annually and monitored at least daily during fuel removal processes for which the CVS is credited.	10 CFR 830, Subpart B

References:

DSA-OR-7503-0007, *Documented Safety Analysis for the Molten Salt Reactor Experiment Facility, Oak Ridge National Laboratory, Oak Ridge, Tennessee*

DSA-OR-7503-0007, A1, *Addendum to Documented Safety Analysis for the Molten Salt Reactor Experiment Facility, Oak Ridge National Laboratory, Oak Ridge, Tennessee*

TSR-OR-MSRE-0008, *Technical Safety Requirements for the Molten Salt Reactor Experiment Facility (MSRE), at Oak Ridge National Laboratory, Oak Ridge, Tennessee*

OR-575, Rev. 7, *Containment Ventilation System Operations*

FD-T-SSI 150, Rev. 0, *Inspection and Testing of HEPA Filtered Systems*

APPENDIX C

FIELD EVALUATION TEAM BIOGRAPHICAL SKETCHES

Ross Harding (Nuclear Facility Safety Deployed Lead)

Mr. Harding holds a BS Degree in Oceanography with minors in Physics and Ocean Engineering from the United States Naval Academy and a MS Degree in Financial Management from Rensselaer Polytechnic Institute. He is a member of the Nuclear Facility Safety organization with over 30 years experience in managing nuclear reactor and non-reactor facility operations.

Larry Perkins (Nuclear Facility Safety Engineer)

Dr. Perkins holds PhD and MS degrees in chemical engineering from the University of Tennessee in Knoxville, TN and a BS degree in chemical engineering from the Tennessee Technological University in Cookeville, TN. Dr. Perkins is a registered Professional Engineer in the state of Tennessee and is serving as a member of the Nuclear Facility Safety organization. Dr. Perkins has extensive experience with the nuclear safety requirements of the MSRE systems, as well as the chemical processes utilized during the decontamination/decommissioning activities.

Douglas Goode (MSRE System Engineer for the CVS)

Mr. Goode holds a Bachelor of Science degree in Chemistry from Washington and Lee University. He has been associated with the MSRE project for five years, principally in the nuclear safety field. He has extensive knowledge of the CVS and the nuclear safety requirements of the system. Mr. Goode has extensive experience with uranium and fluorine chemistry from his long tenure in the uranium enrichment enterprise at Oak Ridge.

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