Department of Energy
National Nuclear Security Administration
Washington, DC 20585

September 2, 2009

OFFICE OF THE ADMINISTRATOR

The Honorable John E. Mansfield
Vice Chairman
Defense Nuclear Facilities Safety Board
625 Indiana Avenue, NW, Suite 700
Washington, D.C. 20004

Dear Mr. Vice Chairman:

On July 12, 2006, Secretary Bodman submitted the Department of Energy's (DOE) revised Implementation Plan (IP) for Defense Nuclear Facilities Safety Board Recommendation 2004-2, *Active Confinement Systems*. Deliverable 8.6.3 of the IP consists of facility-specific confinement ventilation system (CVS) evaluations performed by the site offices in accordance with the Department's Ventilation System Evaluation Guidance. Deliverable 8.6.5 consists of Program Secretarial Office concurrence and approval of the disposition of gaps and upgrades. This letter and its enclosures comprise Deliverables 8.6.3 and 8.6.5 for Waste Solidification Building (WSB) at Savannah River Site (SRS).

In accordance with the IP and National Nuclear Security Administration (NNSA) guidance dated December 6, 2006, the DOE Independent Review Panel (IRP) and the NNSA Central Technical Authority's Chief of Defense Nuclear Safety (CDNS) have performed separate reviews of the evaluation and its conclusions. The CVS evaluation report for WSB and the IRP report are enclosed.

One performance gap was identified. SRS evaluated the cost of a redesign of the Active Confinement Ventilation System (ACVS) and supporting electrical distribution system to safety class requirements. SRS's rough order of magnitude estimate (pre-conceptual level of detail) for design and construction of this modification was $35 million to $50 million, not including additional life-cycle costs associated with operations and testing. SRS concluded that, due to the measures taken to prevent releases of High Activity Waste, there was no discernable benefit from eliminating the identified gap by elevating the functional classification of the WSB ACVS to safety class.

The IRP concluded that SRS's evaluation of physical modifications to close the gap was appropriately performed and agreed with SRS's conclusion that the cost for closing the one gap related to the ACVS not meeting safety class single-failure criterion is not warranted since the ACVS is not required to prevent or mitigate any accidents that impact the public.

The NNSA CDNS and IRP have concluded that the evaluation and its results are technically sound and appropriate, and meet the intent of the IP. Our review concurs with the conclusions reached by the site, IRP, and CDNS.

If you have any questions concerning this letter or its enclosures, please contact me or have your staff contact Kim Loll at (202) 586-8955 or Kim.Loll@nnsa.doe.gov.

Sincerely,

Thomas P. D'Agostino
Administrator

Enclosures

cc: M. Whitaker, Jr., HS-1.1

SEPARATION

PAGE

09 · 1640

Independent Review
of
Savannah River Site
Waste Solidification Building
DNFSB 2004-2
Active Confinement Evaluation

October 2008

Executive Summary

The Independent Review Panel (IRP) reviewed the Savannah River Site (SRS) Waste Solidification Building (WSB) Active Confinement System Evaluation Report utilizing the process and criteria outlined in DOE's *Ventilation System Evaluation Guidance for Safety-Related and Non-Safety-Related Systems* (2004-2 Ventilation System Evaluation Guide).

The WSB is a radioactive waste solidification facility that is divided into High Activity Waste and Low Activity Waste process areas. The WSB design includes an Active Confinement Ventilation System (ACVS), which has several subsystems containing High Efficiency Particulate Air (HEPA) filtered exhaust. The primary functions of the ACVS are to minimize the spread of potentially radioactive airborne contaminants within the WSB, provide dilution airflow to prevent explosions, maintain personnel radiation exposure as low as reasonably achievable, and prevent the release of radioactive contaminants to the environment. Two of the active confinement ventilation systems have been functionally classified as safety significant for protection of the collocated and facility worker based on the Preliminary Documented Safety Analysis (PDSA).

The SRS report evaluated whether appropriate performance criteria had been derived for the ventilation systems, verified that the systems can meet the performance criteria, and determined whether any modifications were warranted to enhance safety performance.

The IRP review of SRS's WSB ventilation report found that it had appropriately followed the 2004-2 Ventilation System Evaluation Guide. Specifically:

- SRS's functional classification review appropriately evaluated the PDSA accident scenarios to determine if the ventilation system were correctly classified.
  A confinement leak path factor of one was utilized in the PDSA evaluation for the unmitigated dose consistent with expectations in the 2004-2 Ventilation System Evaluation Guide.
- SRS performed and documented a detailed review of the ventilation system against the safety class criteria.
- SRS appropriately looked for and identified gaps between the existing system design and the 2004-2 Ventilation System Evaluation Guide (only one gap was identified) and evaluated the cost benefit of resolving the gap.

The IRP recommends that the National Nuclear Security Administration accept the WSB Ventilation System Evaluation as fulfilling the expectations for the facility-specific ventilation system evaluations identified in the Implementation Plan for DNFSB Recommendation 2004-2.

Results of the Independent Review Panel's Review of DNFSB Recommendation 2004-2 Ventilation System Evaluation Report for the Savannah River Site Waste Solidification Building Active Confinement Ventilation System

1.0 INTRODUCTION

The Independent Review Panel (IRP) reviewed the Savannah River Site (SRS) Waste Solidification Building (WSB) Active Confinement System Evaluation Report utilizing the process and criteria outlined in DOE's *Ventilation System Evaluation Guidance for Safety-Related and Non-Safety-Related Systems* (2004-2 Ventilation System Evaluation Guide).

The IRP team reviewed the report to determine whether it was performed in accordance with the 2004-2 Ventilation System Evaluation Guide, to evaluate the appropriateness of the evaluation results and methods proposed for eliminating identified gaps, and to provide any additional input considered appropriate to the responsible program and site offices.

2.0 FACILITY AND VENTILATION SYSTEM OVERVIEW

The WSB is a new Hazard Category 2 facility in final design stage. The WSB is a radioactive waste solidification facility that is divided into High Activity Waste (HAW) and Low Activity Waste (LAW) process areas.

The WSB design includes an Active Confinement Ventilation System (ACVS), which has several subsystems containing High Efficiency Particulate Air (HEPA) filtered exhaust. The primary functions of the ACVS are to minimize the spread of potentially radioactive airborne contaminants within the WSB, provide dilution airflow to prevent explosions, maintain personnel radiation exposure as low as reasonably achievable, and prevent the release of radioactive contaminants to the environment.

The WSB ACVS includes two safety significant confinement ventilation systems:

- A seismic performance category (PC)-3+ safety significant active process vessel vent (PVV) system is used to maintain air flow in the High Activity (HA) process tanks preventing accumulation of hydrogen generated by radiolytic and chemical decomposition. The PVV process exhaust passes through HEPA filtration system.
- A safety significant HAW process rooms exhaust ventilation system is used to protect collocated workers from spills that may occur during operations or maintenance. The exhaust ventilation system is not required to remain operational following a seismic event. The components are, however, seismically designed to retain confinement integrity.

Both the HAW PVV active ventilation system and the HA room exhaust system are backed up by a seismic PC-3+ diesel generator power source in the event of loss of normal power.

3.0 REVIEW RESULTS

3.1 Derivation of Ventilation System Performance Criteria and Confinement Strategy

SRS's WSB ventilation report evaluated whether appropriate functional performance criteria had been derived for the ventilation systems and whether the resultant confinement strategy met the expectations outlined in the 2004-2 for utilization of an active confinement strategy. To perform this review, SRS evaluated the Preliminary Documented Safety Analysis (PDSA) accident scenarios to determine if the ventilation system was correctly classified as safety class, safety significant, or non-safety.

The accident evaluated in the PDSA with the most significant consequences was the design basis fire event(s) for which the unmitigated doses were approximately 7.3 Rem for the maximally exposed offsite individual and 2000 Rem for the collocated worker. The PDSA used a building leak path factor of one. Based upon analysis documented in the PDSA, SRS choose to utilize safety significant active ventilation controls to prevent and mitigate the accidents including a performance category (PC)-3+ seismically qualified HAW PVV ventilation system and a PC-2 seismically qualified HAW process room ventilation system. Other controls are utilized to mitigate accidents, including a safety significant fire suppression system for the HAW process rooms and seismic PC-3+ safety significant passive control features that include HAW process vessels and piping, HAW process and HAW cementation area walls, and fire barriers.

The IRP concludes that SRS's functional classification review appropriately evaluated the PDSA accident scenarios to determine if the WSB ventilation systems were correctly classified.[1] Further, the IRP concludes that the WSB design appropriately utilizes an active confinement strategy which is consistent with expectations identified in the 2004-2 Ventilation System Evaluation Guide.

3.2 Evaluation of Ventilation System against the Selected Performance Criteria

The safety significant subsystems of the WSB ACVS were conservatively evaluated against safety class performance criteria identified in the 2004-2 Ventilation System

[1] A letter from the WSB Acting Federal Project Director to the DNFSB 2004-2 IRP Chair dated July 31, 2008, stated that following submittal of the ventilation evaluation report a design assumption could not be validated and that a potential red oil explosion event could result in consequences exceeding the off-site evaluation guidelines. However, the controls to prevent a red oil explosion would not include active confinement ventilation, so the change would not impact the conclusion of the WSB Ventilation System Evaluation. The IRP agrees with this conclusion.

Evaluation Guide. Attachment 1 of the WSB Evaluation Report provides the summary of evaluation.

The summary provides good assurance that all the criteria were appropriately evaluated. The results of the evaluation indicated that, with one exception, the WSB ACVS met the 2004-2 Evaluation Guide performance criteria. The one exception was that the design of the HAW PVV and HAW ventilation systems did not comply with safety class single-failure criterion. Specifically, the safety significant portion of the electrical distribution system, which provides power to the ACVS SS subsystems does not meet the safety class single-failure criterion, as defined in DOE O 420.1B, *Facility Safety,* and its implementing guide (DOE G 420-1.1, *Nonreactor Nuclear Safety Design Criteria*).

The IRP concludes that SRS appropriately evaluated the WSB ventilation system against the safety class performance criteria in the 2004-2 Ventilation System Evaluation Guide to identify performance gaps.

3.3 Evaluation of Physical Modifications to Enhance Safety Performance

To evaluate closure of the one performance gap, SRS evaluated the cost of a redesign of the ACVS and supporting electrical distribution system to safety class requirements. The ACVS including the safety systems HAW PVV and HAW ventilation subsystems would be redesigned to comply with safety class requirements, PC-3+ seismic criteria. The design modification would provide a safety class ACVS and safety class filtration with dedicated diesel generators located in a separate PC-3+ seismically qualified structure. The electrical distribution system would be redesigned to safety class standards and comply with the requirements in DOE O 420.1B, DOE G 420-1.1, and applicable Institute of Electrical and Electronics Engineers (IEEE) standards. SRS's rough order of magnitude estimate (pre-conceptual level of detail) for design and construction of this modification was $35 to $50 million, not including additional life-cycle costs associated with operations and testing.

SRS concluded that, due to the measures taken to prevent releases of HAW material, there was no discernable benefit from eliminating the identified gap by elevating the functional classification of the WSB ACVS to safety class.

The IRP concludes that SRS's evaluation of physical modifications to close the gap was appropriately performed and agree with SRS's conclusion that the cost for closing the one gap related to the ACVS not meeting safety class single-failure criterion is not warranted since the ACVS is not required to prevent or mitigate any accidents that impact the public.

4.0 CONCLUSION

The IRP concludes that SRS's evaluation of the WSB confinement ventilation system was appropriately performed in accordance with the criteria in the 2004-2 Ventilation System Evaluation Guide.

The SRS's functional classification review appropriately evaluated the PDSA accident scenarios to determine if the ventilation systems were classified at the appropriate safety designation and whether an appropriate confinement strategy was employed. SRS conservatively evaluated the ventilation system against the safety class criteria in the 2004-2 Evaluation Guide criteria. SRS performed and documented a detailed review of the ventilation system against the safety class criteria. SRS appropriately looked for and identified gaps between the existing system design and the 2004-2 Evaluation Guide (only one gap was identified) and evaluated the cost benefit of resolving the gap.

The IRP agrees with the SRS conclusion that the cost for closing the one gap related to the ACVS not meeting safety class single-failure criterion is not warranted since the ACVS is not required to prevent or mitigate any accidents that impact the public.

5.0 RECOMMENDATION

The IRP recommends that NNSA accept the WSB Ventilation System Evaluation as fulfilling the expectations for the facility-specific ventilation system evaluations identified in the Implementation Plan for DNFSB Recommendation 2004-2.

6.0 REVIEW TEAM MEMBERS

James O'Brien	IRP Chairman (Office of Health, Safety and Security)
Pranab Guha	IRP Support (Office of Health, Safety and Security)
Teresa Robbins	IRP member (National Nuclear Security Administration)

References:

- SRS Waste Solidification Building DNFSB Recommendation 2004-2 Ventilation System Evaluation, dated June 2008, Rev. 2
- Memorandum from Thomas Cantey to James O'Brien, dated July 13, 2008
- SER for the Waste Solidification Building (WSB) Preliminary Documented Safety Analysis WSRC-SA-2003-000 Rev. 0, dated August 2008

SEPARATION

PAGE

09 · 1640

Revision 3
March 2009

Savannah River Site

Waste Solidification Building

DNFSB Recommendation 2004-2 Ventilation System Evaluation

UNCLASSIFIED
DOES NOT CONTAIN UNCLASSIFIED
CONTROLLED NUCLEAR INFORMATION

DC/RO: [signature] Date 3/23/2009

Organization WNP-DAE Guidance IG-SR-3

Savannah River Site
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Table of Contents

List of Figures

List of Tables

Definitions

Active Confinement Ventilation System	A ventilation system that confines hazardous materials by performing an active function. The system may consist of air supply, recirculating air, process ventilation, and exhaust air systems, together with associated air filters, fans, dampers, ducts, control instrumentation and supporting systems (such as power supply and facility structure). This system is typically designed using a cascading system that starts with clean air from outside the building or from hallways or office spaces; through the laboratories or room where activities are performed; through the gloveboxes, tanks and vessels where the highest concentrations of hazardous materials may exist; and out to the environment through filters. This system can be effective for confining hazardous materials during normal operation and additionally for accident events. A safety-related active confinement ventilation system must meet appropriate requirements for the designated functional classification in order to be included in the facility safety basis.
Confinement	A building, 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.
Containment	A barrier that precludes release of radionuclides by maintaining a mechanical seal with a quantified leakage requirement.
Hazard Category	Hazard Category is based on radiological inventory and its effects to offsite, onsite, and local workers.
High-Efficiency Particulate Air (HEPA) Filter	An extended-pleated-medium dry-type filter with (1) a ridged casing enclosing the full depth of the pleats, (2) a minimum particle removal efficiency of 99.97 percent for particles with diameter of 0.3 micrometers, and (3) a maximum pressure drop of 1.0 in.wg. or 1.3 in.wg. when clean and operated at its rated flow capacity.
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.
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.

Abbreviation and Acronyms

ACVS	Active Confinement Ventilation System
ALARA	As Low As Reasonably Achievable
CHA	Consolidated Hazards Analysis
CW	Co-located Worker
DBA	Design Basis Accident
DF	Decontamination Factor
DG	Diesel Generator
DID	Defense in Depth
DNFSB	Defense Nuclear Facilities Safety Board
DOE	Department of Energy
DSA	Documented Safety Analysis
EG	Evaluation Guideline
FDD	Facility Design Description
FHA	Fire Hazards Analysis
FW	Facility Worker
HAW	High Activity Waste
HEPA	High Efficiency Particulate Air
HVAC	Heating, Ventilating and Air Conditioning
IEEE	Institute of Electrical and Electronics Engineers
LAW	Low Activity Waste
LFL	Lower Flammability Limit
LOPA	Layer of Protection Analysis
LPF	Leak Path Factor
MAR	Material At Risk
MFFF	MOX Fuel Fabrication Facility
MOI	Maximally Exposed Offsite Individual
NFPA	National Fire Protection Association
NNSA	National Nuclear Security Administration
NPH	Natural Phenomena Hazard
NRC	Nuclear Regulatory Commission

PC	Performance Category
PC-3+	Performance Category 3 as augmented by NNSA direction on seismic intensity (Uses NRC 1.60 seismic response spectra) [Note: See Section 1.1 for additional discussion.]
PDCF	Pit Disassembly and Conversion Facility
PDSA	Preliminary Documented Safety Analysis
PGA	Peak Ground Acceleration
PVV	Process Vessel Vent
rem	Roentgen Equivalent Man
SC	Safety Class
SDD	System Design Description
SIL	Safety Integrity Level
SRS	Savannah River Site
SS	Safety Significant
SSCs	Structures, Systems, and Components
TRU	Transuranic
WSB	Waste Solidification Building

Executive Summary

This report documents the results of the Ventilation System Evaluation for the Waste Solidification Building (WSB) conducted in accordance with DOE Guide, "Ventilation System Evaluation Guidance for Safety-Related and Non-Safety-Related Systems" (Reference 5). This guide provides the methodology for ventilation system evaluations of DOE facilities (existing and new) addressed in DOE Implementation Plan for DNFSB Recommendation 2004-2 (Reference 7). The purpose of the evaluations is to: (a) verify that appropriate performance criteria are derived for ventilation systems, (b) verify that these systems can meet the performance criteria, if applicable, and (c) determine if any physical modifications are necessary to enhance safety performance.

The WSB project supports the National Nuclear Security Administration (NNSA) strategic goal to protect or eliminate weapon-usable nuclear material. The mission of the WSB is to process and solidify the liquid waste from the MOX Fuel Fabrication Facility (MFFF) and the Pit Disassembly and Conversion Facility (PDCF). The WSB will be a Hazard Category 2 facility located adjacent to PDCF and MFFF at the Savannah River Site (SRS) in F-Area. The process building will be a two-story, reinforced concrete structure located at grade designed to exceed the requirements for a Performance Category PC-3 structure.

The WSB design includes an Active Confinement Ventilation System (ACVS) which has several subsystems containing High Efficiency Particulate Air (HEPA) filtered exhaust. The primary functions of the ACVS are to minimize the spread of potentially radioactive airborne contaminants within the WSB, provide dilution airflow to prevent explosions, maintain personnel radiation exposure ALARA and prevent the release of radioactive contaminants to the environment. This system provides confinement by maintaining an airflow gradient that moves air from areas of less contamination to areas of higher contamination before being exhausted through HEPA filters and the exhaust stack. To accomplish this airflow gradient, the WSB is designed with primary, secondary and tertiary confinement zones, which are maintained at required differential pressure.

Two of the ACVS subsystems have been functionally classified as Safety Significant (SS) for protection of the co-located and facility worker based on the Preliminary Documented Safety Analysis (PDSA) (Reference 1) and the Consolidated Hazards Analysis (CHA) (Reference 2). The High Activity Waste (HAW) Process Vessel Vent (PVV) subsystem provides dilution airflow to the HAW process vessels. Dilution air prevents an explosion due to hydrogen accumulation in the HAW process vessels. The HAW Ventilation System provides filtration of airborne hazardous material in the event of a spill in the HAW Process Room, HAW sample glovebox, laboratory glovebox and HAW and LAW cementation mixing system enclosures. In addition to these SS ACVS features, the WSB design includes a SC HAW high evaporator temperature interlock, SC HAW evaporator vent path, SS Fire Suppression System in the HAW Process Room and Cementation Area; SS Building Structure and HAW Process Area construction; SS HAW evaporator high steam pressure interlock, SS HAW vessels, valves and piping; SS LAW high evaporator temperature and high steam pressure interlocks, SS LAW evaporator vent path, and SS enclosures/gloveboxes for the locations where HAW is removed from the HAW Process Room.

In accordance with Reference 5, a PDSA evaluation was conducted. A summary of the PDSA bounding design basis events and related data (Table 4.3) was compiled and used in performing the evaluation of the WSB ventilation system design vs. performance criteria. The unmitigated dose consequences presented in the table assumed no credit for passive or active engineered features of the design. This evaluation concluded that the PDSA and CHA identify one design basis events that challenge the offsite Evaluation Guideline contained in DOE-STD-3009-94 Several events have consequences that exceed 1 rem to the MOI. Therefore, the WSB ACVS was evaluated against the SC performance criteria. In addition, several events in the PDSA and CHA merited consideration for SS controls for the co-located and facility workers. The PDSA and CHA identified safety class controls to prevent the Red Oil Explosion. The safety features credited in the PDSA and CHA were found to provide protection that meets or exceeds the requirements in DOE-STD-3009-94. The HAW PVVS serves as the SS primary preventer for hydrogen explosions. The HAW Process Room ventilation provides the SS primary mitigation for the piping leak/spill scenario. Based on these results, the WSB evaluation team believes that the WSB safety strategy is prudent, cost effective and provides appropriate protection to the public, co-located worker and facility worker.

The Waste Solidification Building Safety Documentation was written to comply with 10 CFR 830 and DOE-STD-3009-94. After the development of the WSB preliminary safety analysis, DOE-STD-1189-2008 was approved. An evaluation was performed to determine the impacts to the WSB project from the implementation of DOE-STD-1189-2008. This evaluation determined there are differences in format and methodology for the safety analysis. One of the greatest differences is the methodology for calculation of consequence to the 100-meter receptor. A comparison of the consequences between the safety documentation and DOE-STD-1189-2008 methodology show a significant increase in dose potential to the co-located worker. Because Safety Significant SSCs and SACs are already in the WSB design to prevent or mitigate these events, there is no impact to the design for the WSB project. All scenarios have been quantitatively evaluated with respect to unmitigated dose, and in all cases the conclusion was that the previously selected controls were adequate to reduce consequences below guidelines using DOE-STD-1189-2008 methodology.(Reference 1)

Following the PDSA evaluation, an assessment was performed to evaluate the credited features of the ACVS to the specified Safety Class (SC) performance criteria of Reference 5 and to identify any gaps between the criteria and the design. As stated in Reference 5, as part of DOE's response to Recommendation 2004-2, the performance criteria are used for evaluation purposes and are not to be considered new requirements. Furthermore, this ACVS evaluation was performed because the SC performance criteria reflect important attributes that should be considered in the design of a new system.

Only one gap was identified by the evaluation; the design of the ACVS SS subsystems (HAW PVV and HAW Ventilation) did not comply with SC single-failure criterion. The SS portion of the electrical distribution system, which provides power to the ACVS SS subsystems does not meet the SC single-failure criterion, as defined in DOE O 420.1B (Reference 8) and DOE G 420-1.1 (Reference 9). DOE G 420.1-1 requires SC electrical systems to meet several IEEE standards which the WSB electrical distribution system is not designed to meet.

To evaluate closure of this gap, a redesign of the ACVS and supporting electrical distribution system to SC requirements was developed. The ACVS including the SS HAW PVV and HAW Ventilation subsystems would be redesigned to comply with SC requirements, PC-3+ seismic criteria and PC-3 criteria for other Natural Phenomena Hazard (NPH) events. (See Section 1.1 for a definition of PC-3+, as it applies to the WSB design). The design modification would provide a SC ACVS and SC filtration with dedicated diesel generators located in a separate PC-3+ qualified structure. The electrical distribution system would be redesigned to SC standards and comply with the requirements in DOE O 420.1B, DOE G 420-1.1 and applicable IEEE standards. The rough order of magnitude estimate (pre-conceptual level of detail) for design and construction of this modification is \$35 to \$50 million. The estimate does not include additional lifecycle cost associated with operations and testing.

In summary, the PDSA and CHA identify one design basis events that challenge the offsite Evaluation Guideline contained in DOE-STD-3009-94 and several events that exceed the SS criteria for co-located and facility workers. The safety features credited provide protection that meets or exceeds the requirements in DOE-STD-3009-94. The facility design provides sufficient passive and active features to prevent and mitigate the consequences well below the worker criteria or the ventilation evaluation criteria of 1 rem to an offsite individual. Due to the measures taken to prevent releases of HAW material, there is no discernable benefit from eliminating the identified gap by elevating the functional classification of the WSB ACVS to SC.

1.0 Introduction

1.1 Facility Overview

The Waste Solidification Building (WSB) project supports the National Nuclear Security Administration (NNSA) strategic goal to protect or eliminate weapon-usable nuclear material. The mission of the WSB is to process and solidify the liquid waste from the MOX Fuel Fabrication Facility (MFFF) and the Pit Disassembly and Conversion Facility (PDCF). The WSB will be a Hazard Category 2 facility to be located adjacent to PDCF and MFFF at the Savannah River Site (SRS) in F-Area. The process building will be a two-story, reinforced concrete structure located at grade. The first level of the process building will be approximately 33,000 square feet and will house the waste receipt tanks, evaporators, cementation equipment, and laboratory equipment. The second level of the process building will primarily house piping and sampling ports for the High Activity Waste (HAW) process. Figure 1 and 2 provide the floor plans for the 1st and 2nd levels. The building structure is designed to the requirements for a Performance Category PC-3+ structure. The WSB will support the MFFF and PDCF, with a fifteen year operation period and has a thirty year design life.

Based on technical direction from the NNSA, the WSB project uses seismic design criteria that match the peak ground acceleration (PGA) of 2.0g, vs. the 1.6g typically used at the SRS for a Design Basis Earthquake for a PC-3 facility. The use of this higher PGA for the WSB is consistent with the seismic design criteria used for the neighboring (in design/under construction) PDCF and MFFF. Likewise, the WSB technical direction for tornado/higher wind events is to use PC-3 performance criteria for the building structure and any other features credited to perform a safety function during or following a high wind event. For the sake of brevity, this performance criterion for Natural Phenomena Hazard (NPH) events is referred to as PC-3+ in this evaluation and in other project documentation.

The HAW Process Room and Cementation Area house the vessels, piping and equipment that will receive and process the MFFF High Alpha liquid waste stream. The HAW Process and Cementation Areas are separated from each other and from the rest of the facility by seismically qualified fire barrier walls. The HAW Process Area includes the process room, hot maintenance room, TRU job waste processing room, process support room, PCS Room #4, and airlocks on the first floor; and process support room and airlocks on the second floor. The first level HAW Process Room is divided into four stainless steel lined sections which are separated from each other by partition walls that extend only to the 2nd level of the building and share a common ventilation system. The HAW process vessels and piping, HAW Process Vessel Vent (PVV) System, diesel generator, and HAW Process and Cementation Area walls are designed to meet PC-3+ seismic criteria.

The Low Activity Waste (LAW) Processing Area and Cementation Area house the vessels, piping, and equipment that will receive and process the MFFF Stripped Uranium and PDCF Laboratory liquid waste streams. The LAW Process Area, Laboratory, support equipment rooms, and personnel areas occupy the majority of the 1st level floor plan.

1.2 Confinement Ventilation System/Strategy

The WSB is designed with multiple active confinement systems with High Efficiency Particulate Air (HEPA) filtered exhaust. A simplified flow diagram of the WSB Active Confinement Ventilation System (ACVS) is provided in Figure 3.

The primary function of the ACVS is to minimize the spread of potentially radioactive airborne contaminants within the WSB, maintain personnel radiation exposure ALARA, provide dilution airflow to prevent flammable gas buildup, and prevent the release of radioactive contaminants to the environment. This system provides confinement by maintaining an airflow gradient that moves air from areas of less contamination potential to areas of higher contamination potential before being exhausted through HEPA filters and the exhaust stack. To accomplish this airflow gradient, the WSB is designed with primary, secondary and tertiary confinement zones, which are maintained at required differential pressure. The primary confinement zone consists of the HAW and LAW process vessels, cementation drums and cementation enclosures as well as the gloveboxes (HAW sample and laboratory). The secondary confinement zone consists of the HAW and LAW process and cementation areas; laboratory area and hoods; HEPA filter rooms and hot maintenance room. The tertiary confinement zone includes the various rooms, air locks and corridors between the process, cementation, laboratory and clean areas. The clean area includes the mechanical and electrical equipment rooms, control room, change rooms and offices.

The ACVS is comprised of the following subsystems:

- Process Vessel Vent (PVV) System
  - HAW PVV subsystem
  - LAW PVV subsystem
- HAW Ventilation System
  - HAW Process Room Ventilation subsystem
  - HAW Cementation Enclosure Ventilation subsystem
  - LAW Cementation Enclosure Ventilation subsystem
  - HAW Sample Glovebox Ventilation subsystem
  - Laboratory Glovebox Ventilation subsystem
- Building Exhaust System
- Air Supply System
  - Process Area Air Supply subsystem
  - Laboratory Area Supply subsystem
- Clean Area HVAC System

Process Vessel Vent System

The HAW and LAW PVV subsystems remove gases from the process vessels and cementation drums during the mixing process. Each vessel has a connection to one of the PVV subsystems. The PVV maintains a differential pressure between the vessels and the process room, and this differential pressure provides a minimum flow through the vapor space of each vessel. Building air is introduced into the process vessel through HEPA filters. The exhaust air flows through a condenser and demister. The exhaust air exits the demister and is heated above the dew point by an electric coil. The air is then exhausted through two stages of HEPA filters (two trains of HEPA filters with one train on standby). The HAW PVV is exhausted directed to the WSB exhaust stack. The LAW PVV is exhausted through the exhaust stack via the Building Exhaust System. Two dedicated exhaust fans are provided for each subsystem with one running and one in automatic standby. The HAW PVV subsystem is also provided with an external connection point (located outside the WSB structure in the common header downstream of HEPA filters, as shown in Figure 3) where a portable fan can be connected to the PVV system to support planned maintenance outages or facility recovery efforts. The HAW PVV subsystem is provided with automatic backup power from a diesel generator system. The HAW PVV subsystem and diesel generator system are designed for PC-3+ seismic criteria and PC-3 criteria for other NPH events.

HAW Ventilation System

The HAW Ventilation System removes and filters the air from the HAW Process Room, HAW and LAW cementation enclosures, HAW sample glovebox and laboratory glovebox. The process room, gloveboxes, and enclosures are exhausted through multiple sets of two-stage HEPA filters, as shown in Figure 3. The redundant HEPA filter trains are configured such that one HEPA set is operating while the second is in standby in case of a problem with the operating set. Exhaust ductwork from the process room up to and including the first HEPA filter is designed to meet PC-3+ seismic criteria. Two fans installed in parallel (one operating and one in standby) provide motive force for the exhaust. The diesel generator provides back-up power in the event of normal power loss. The exhaust fans are designed to meet PC-2 criteria.

Building Exhaust System

The Building Exhaust System removes and filters the air from the LAW Process Room, HAW and LAW Cementation Areas, Laboratory Area and hoods, HEPA filter rooms, job control solid waste processing room and hot maintenance room. Air from these rooms (secondary confinement) and air from the rooms in the tertiary confinement zone are exhausted through a single stage HEPA filter and two building exhaust fans (one operating and one in standby) to the exhaust stack.

Air Supply System

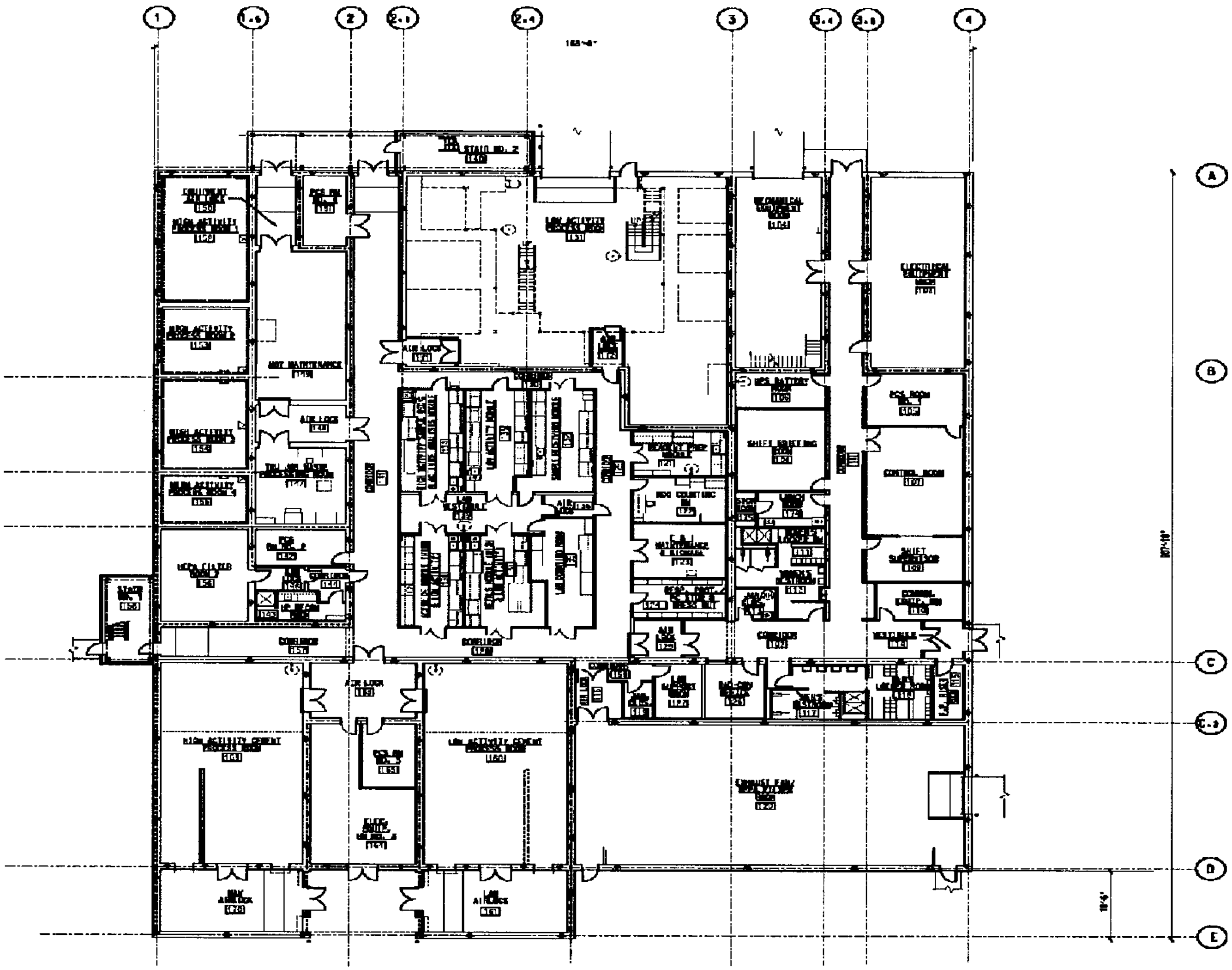
The Air Supply System provides conditioned air to the HAW and LAW Process Areas, HAW and LAW Cementation Areas, Laboratory Area, and support areas. This supply system brings 100% outside air into the air handling units where the air is filtered, heated or cooled to meet temperature and humidity requirements. Each air handling unit is equipped with two supply fans, one operated while the others is in a standby mode.

Clean Area HVAC System

The Clean Area HVAC System provides conditioned air to the various administrative areas including the control room. Outside air and return air is mixed in the plenum, filtered, then heated or cooled before delivery to the clean area via the supply fan. The HVAC unit will be controlled by the control room thermostat.

1.3 Major Modifications

This section does not apply to the WSB project. The WSB is a new project in support of the Surplus Plutonium Disposition Program and is in the Construction phase.



Note: HAW Process Room 152-155, as shown on this floor plan, corresponds to the HAW Process Room described in the text of this document.

Figure 1 – WSB Process Building 1st Level Floor Plan

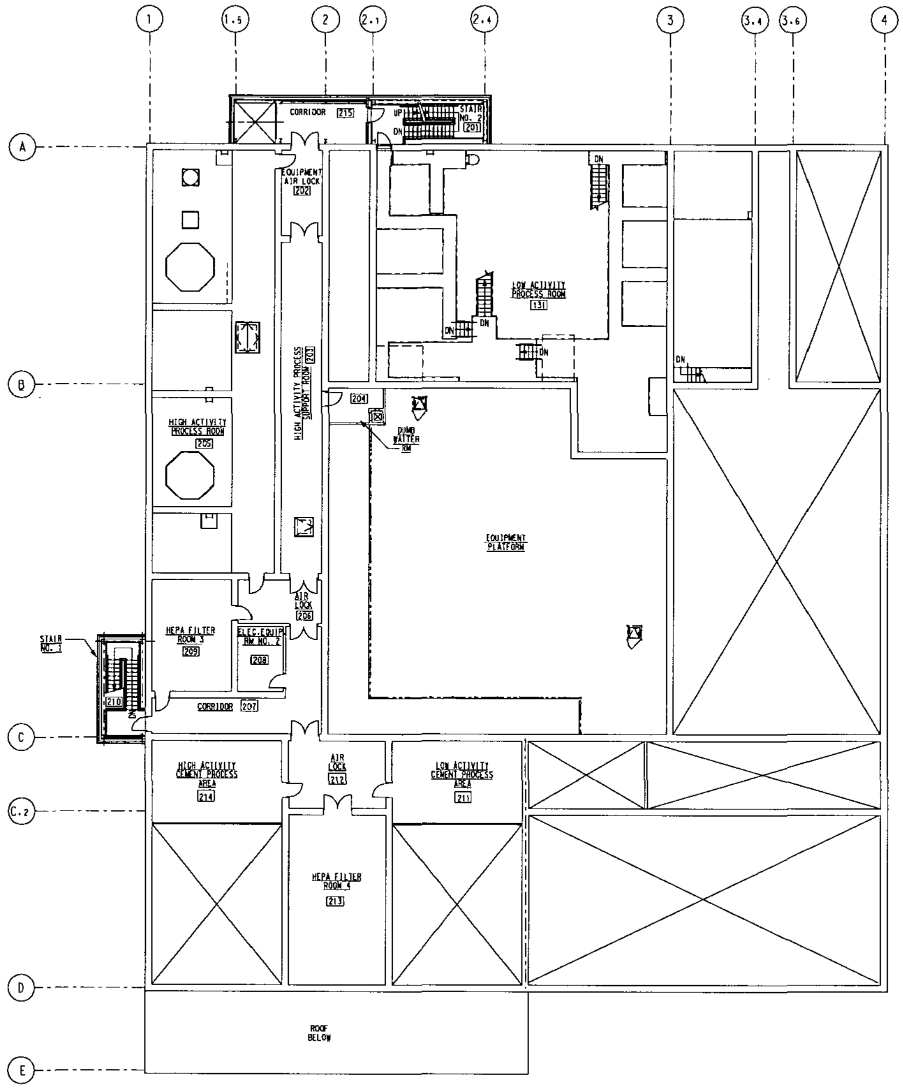


Figure 2 – WSB Process Building 2nd Level Floor Plan

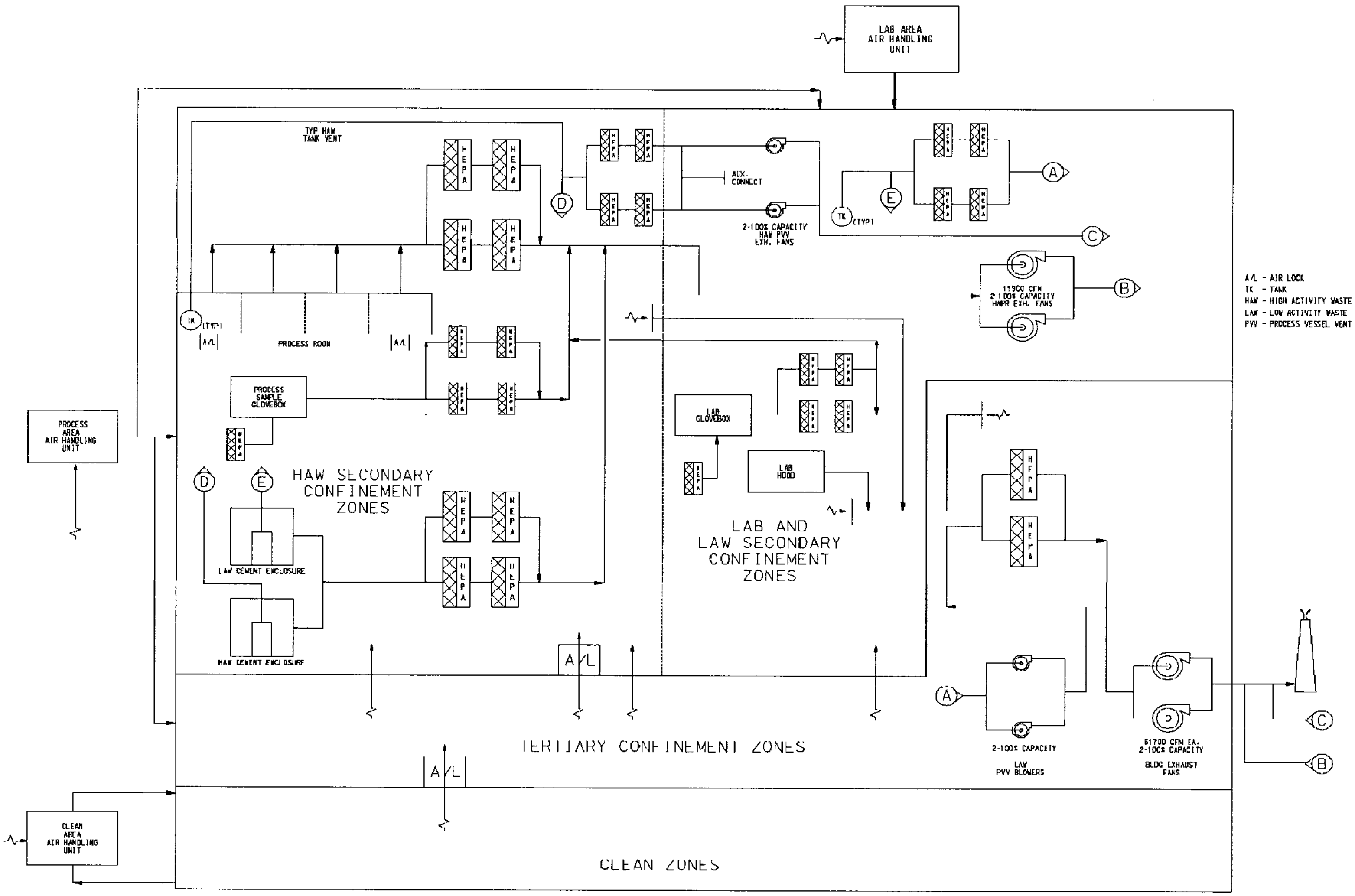


Figure 3 - Active Confinement Ventilation System (ACVS) Flow Diagram

2.0 Functional Classification Assessment

2.1 Existing Classification

Based on the Preliminary Documented Safety Analysis (PDSA) (Reference 1) and the Consolidated Hazards Analysis (CHA) (Reference 2), the HAW PVV subsystem and the HAW Ventilation System have been functionally classified as Safety Significant (SS) for protection of the co-located and facility workers. The HAW PVV subsystem provides dilution airflow to the HAW process vessels and cementation drums during the mixing process to prevent an explosion due to hydrogen accumulation in the process vessels and drums. The HAW Ventilation System provides filtration of airborne hazardous material in the event of a spill in the HAW Process Room, HAW sample glovebox, laboratory glovebox and HAW and LAW cementation enclosures.

2.2 Evaluation

The PDSA and CHA identify one Design Basis Accidents (DBAs) that challenge the public evaluation guideline (25 rem) from DOE-STD-3009-94 (Reference 3). Several accidents exceed the co-located and facility worker SS criteria (100 rem) in the SRS functional classification Manual E7, Procedure 2.25 (Reference 4). The HAW Evaporator red oil explosion yields the highest unmitigated offsite dose of 124 rem and 33,000 rem for the co-located worker. See Attachment 1 for a list of the DBAs. All consequence calculations are based on 95% meteorology and 100 cm surface roughness factors for the offsite receptors and 50% meteorology and 100 cm surface roughness factors for the CW at 100m. Fire releases are assumed to have 20-minute duration; all other events are assumed to have release duration of 3-minutes.

The Waste Solidification Building Safety Documentation was written to comply with 10 CFR 830 and DOE-STD-3009-94. After the development of the WSB preliminary safety analysis, DOE-STD-1189-2008 was approved. An evaluation was performed to determine the impacts to the WSB project from the implementation of DOE-STD-1189-2008. This evaluation determined there are differences in format and methodology for the safety analysis. One of the greatest differences is the methodology for calculation of consequence to the 100-meter receptor. A comparison of the consequences between the safety documentation and DOE-STD-1189-2008 methodology show a significant increase in dose potential to the co-located worker. Because Safety Significant SSCs and SACs are already in the WSB design to prevent or mitigate these events, there is no impact to the design for the WSB project. All scenarios have been quantitatively evaluated with respect to unmitigated dose, and in all cases the conclusion was that the previously selected controls were adequate to reduce consequences below guidelines using DOE-STD-1189-2008 methodology.

The table in Attachment 1 provides a summary of the bounding design basis events to be used in performing the evaluation of the WSB ventilation systems design vs. the performance criteria. The unmitigated dose consequences assume no credit for passive and active engineered features of the design. The Attachment 1 table was completed in accordance with DOE Ventilation System Evaluation Guide (Reference 5). This table is labeled as Table 4.3, Confinement Documented Safety Analysis Information, the same number and title as that given in Reference 5.

The strategy for controls selection and functional classification for the WSB project included reviewing all the accident scenarios and applying robust controls for the accident scenarios. The priority for control selection was consistent with established hierarchy for control selection, to wit:

- Active and passive controls were selected over administrative controls.
- Passive features were selected over active features.
- Preventive controls were selected over mitigative controls.
- Controls were selected closest to the hazard and, where possible, between the hazard and the nearest receptor.
- Controls common to many events were selected.

Scenario development for the DBAs was also conservative. The HAW Evaporator Red Oil Explosion conservatively assumes the evaporator contains 6 kg Am-241, the maximum inventory of a single vessel. The consequences for this event are calculated using the bounding ARF*RF values from the DOE-HDBK-3010-94 (Reference 6) for a pressurized release from a ruptured vessel at 50 to 100° C superheat with a 6 kg of Am-241 vessel inventory. For this and all scenarios, a building Leak Path Factor (LPF) of one (1) was used to calculate the unmitigated dose consequences taking no credit for the seismically qualified building structure or confinement ventilation system.

The HAW Evaporator Red Oil Explosion scenario is prevented through the application of SC and defense in depth SS controls. The control philosophy described in DNFSB Tech 33 Report for control of red oil explosions was applied in the selection of controls. Five controls were selected, which when combined, are sufficiently robust to prevent a red oil explosion. Three of the controls are engineered controls that prevent the conditions necessary for decomposition of TBP in the HAW Evaporator. The first SC control is the HAW evaporator high temperature interlock system which prevents the temperature of the evaporator contents from exceeding the initiation temperature for a runaway red oil reaction. The second SC control is a vent path on the HAW evaporator to prevent the pressure explosion that could occur in unvented or inadequately vented vessels during a red oil reaction. Sufficient venting also has the added benefit of allowing the solution to self cool by evaporative heat transfer thus allowing the reaction rate of the TBP decomposition reaction to decrease, thereby preventing the red oil explosion. The third SS defense in depth control is an evaporator high steam pressure interlock system to prevent the steam coil pressure from exceeding a value that could result in a high evaporator temperature. An AC requiring sampling of the HAW evaporator head tank contents prior to evaporation was also selected to provide a SC function to protect the organic content assumptions used to size the vent path. This ensures that accumulation of TBP received in the MFFF HAW stream or transferred from the LAW process via LAW evaporator overheads in the HAW evaporator head tank will be detected. In addition, the WAC Program requiring that the organic content in the waste received from the MFFF is limited to trace quantities was selected as defense in depth SS function.

The HAW Process Room Fire assumes that the building contains approximately nine months worth (18 kgs of Am-241) of the worst case receipts (highest Am-241 content allowed by the WSB Waste Acceptance Criteria) in the process vessels, that a fire occurs, and the entire building's HAW process vessel inventories are subjected to vigorous boiling over a 20 minute period of time. The bounding ARF*RF value from the DOE-HDBK-3010-94 (Reference 6) for a ground level boiling release of the 18 kgs of Am-241 inventory was used to calculate the unmitigated dose consequences for this scenario. For this scenario, a building Leak Path Factor (LPF) of one (1) was used which takes no credit for the seismically qualified building structure, HAW Process Room fire barrier walls with seismically qualified fire doors and seismically qualified (to provide confinement boundary) HEPA filters in the HAW Process Room exhaust ductwork.

In addition, an alternate calculation has been developed using a different methodology for this scenario. This alternate methodology assumes that the entire floor space under all of the HAW process vessels is loaded with transient combustibles to the maximum extent reasonable for a facility of this type construction, access, and utilization. All of this combustible material is concentrated under the optimum volume of HAW material in a process vessel and is burned. Using the bounding formula in DOE-HDBK-3010-94 for a large room fire, the dose consequences from the release are calculated. Conservatisms and bounding assumptions used in this calculation include: 1) HAW material is at the bounding Am-241 concentration (2 gm/liter), 2) HAW material is at the optimum volume (i.e., If more material is present, solution does not boil to dryness with approximately a 3X reduction in release fraction for vigorous boiling release vs. a boil to dryness release, AND IF less material is present, release fraction decreases linearly due to a decrease in MAR.), 3) the starting ratio of nitric acid to water is assumed to be the azeotrope so that the heat of vaporization is minimized for the HAW solution involved, 4) the release is assumed to take place over a 20 minute period of time, and 5) the bounding ARF*RF value from DOE-HDBK-3010-94

(Reference 6) is used. This alternate calculation results in a lower dose than the previously described methodology.

The HAW Process Room fire described in this scenario is mitigated by the SS Fire Suppression System which prevents a boiling release of the HAW process vessel contents. This applies to fires caused by normal operations such as maintenance where transient combustibles would be brought into the HAW Process Room and ignited by a spark or hot work. Fires initiating outside the HAW Process are prevented from propagating into the HAW Process Room by the PC-3+ seismically qualified fire barrier walls (passive design features). A post seismic fire of sufficient magnitude to cause a boiling release of the contents of the HAW process vessels is considered a beyond design basis event due to the design features associated with in the HAW Process Room including low installed combustible loading, the absence of flammable liquids and gases, and the PC-3+ seismically qualified fire barrier wall design feature of the HAW Process Room.

Consistent with the conservative approach described above for the HAW Process Room Fire accident scenario, the seismic event assumes the process vessel vent system is damaged, loses power, or fails and a fire is initiated in laboratory or maintenance area. The unmitigated consequences are based on a hydrogen explosion in the HAW process area and a propagated fire involving the LAW, laboratory, and cementation area inventories. Hydrogen is conservatively assumed to accumulate for 14 days and reach the stoichiometric hydrogen to air mixture. The unmitigated dose consequences were calculated using the TNT equivalent model assuming a bounding americium solution concentration and a ground level unfiltered release. Again, a building LPF of one (1) is used which takes no credit for the robust structure and containment features described previously. The explosion is prevented from occurring when credit is taken for the PC-3+ seismically qualified, SS HAW process vessel vent system and diesel generator backup power designed to survive an earthquake using a seismic response spectra that is consistent with the Nuclear Regulatory Commission (NRC) seismic response spectra used at Plant Vogtle. These spectra exceed the criteria used by DOE for other PC-3 qualified facilities at SRS.).

The piping leak/spill scenario assumes that a transfer of the entire contents of a single HAW vessel filled with the maximum inventory of HAW (6 kgs of Am-241) is initiated. There is a catastrophic failure of the transfer piping at the highest point in the HAW Process Room (30 foot elevation) resulting in the entire contents of the HAW vessel falling to the HAW floor from the failed piping. The unmitigated consequences are based on a ground level unfiltered release and the bounding ARF*RF values for a spill from a height of 30 feet were calculated using the methodology provided in DOE-HDBK-3010-94. A building LPF of one (1) is used. This is a bounding analysis for the spill scenario and is based on an elevated release that pumps the entire tank contents through an open ended pipe onto the HAW Process Room floor. The release is mitigated by the SS HAW Ventilation System.

Conservatisms in this scenario include the release quantity, the release elevation, the scenario selected for the process room spill, etc. The piping above the vessel is welded construction and has no valves at the higher elevations. No credit is taken for operator response to area radiation alarms or tank level indication which would initiate a response action, stopping the transfer, prior to spilling the entire tank contents. The leak is assumed to be catastrophic resulting in the release of the entire tank contents with no warning vs. a more realistic scenario involving only a fraction of the transfer volume. The failure is assumed to be at the highest point physically possible in the HAW Process Room while only a small fraction (if any) of the HAW process piping would be expected to be at that elevation. Note that a tank leak at an elevation consistent with the vessel leaking (at or below 3 meters) would result in dose consequences to the MOI below 1 rem.

The hydrogen explosion scenario assumes process vessel vent airflow is lost to the HAW vessel and hydrogen is conservatively assumed to accumulate and reach the stoichiometric hydrogen to air mixture. The unmitigated consequences are based on the TNT equivalent model assuming that the HAW waste receipt tank is nearly empty while assuming there is sufficient inventory available for release, thus maximizing the amount of energy available for the dispersion of the inventory. The consequences of this scenario are based on a ground level unfiltered release. Again, a building Leak Path Factor (LPF) of one (1) is used.

The only WSB DBA scenario that exceeds 1 rem in dose to the MOI where an ACVS is the only credited mitigator is the spill scenario in the HAW Process Room. The HAW Red Oil Explosion scenario is prevented by the SC HAW evaporator temperature interlock system, the evaporator vent path, and the three SS controls. Fire scenarios are mitigated by fire suppression systems and seismically qualified fire barriers rather than by crediting the ventilation system. NPH events are mitigated/release prevented through NPH qualified SSCs that prevent the material from being released. A significant post seismic fire in the HAW Process Room is not credible due to the materials of construction and low combustible loading design features for that fire zone (nor can a post seismic fire propagate into the HAW process room due to the seismically qualified fire barrier walls). While the HAW explosion scenarios are prevented by the PVV system, the only credited attribute of the PVV system is the dilution air flow to maintain tank head space below the LFL, but no mitigation is attributed to the filtration provided by the HEPA filters in the PVV system to prevent release of tank contents.

When taken as a whole, the paragraph above suggests that only the HAW Ventilation System merits serious consideration as a Safety Class ACVS, for the purposes of this ventilation system evaluation. While the other scenarios exceed 1 rem for their unmitigated consequences, other systems (not ACVS) reduce the dose consequence below 1 rem to the MOI or prevent the event. The HAW spill scenario in particular has a dose consequence of 2.1 rem to the MOI, which exceeds the 1 rem evaluation guideline suggested in the Evaluation Guideline by a small margin, but is an order of magnitude below 25 rem from DOE-STD-3009-94. The application of the conservatisms described in the evaluation for this scenario provides a bounding scenario.

Escalating the functional classification of the confinement ventilation system to SC will not result in more protection to the public or facility worker since reliable, robust, multi-level controls have already been selected.

The SC active controls/features include: 1) HAW evaporator high temperature interlock system to prevent the temperature of the contents of the HAW evaporator from exceeding 130°C and 2) HAW evaporator vent path to provide a sufficient vent area to limit pressurization in the evaporator such that the contents will not reach the red oil explosion autocatalytic temperature.

The SS passive controls/features include: 1) a seismically qualified passive reinforced concrete structure that is designed to PC-3+ criteria, 2) seismically qualified passive fire barrier walls around HAW Process and Cementation Areas that meet PC-3+ criteria, 3) seismically qualified passive fire barrier walls around the PVV subsystem rooms that meet PC-3+ criteria, 4) stainless steel liners in the HAW process rooms to contain spilled material, 5) vessels and piping that meet PC-3+ criteria to prevent seismically induced spills, and 6) low combustible design in the HAW Process Room to reduce the potential for and intensity of fires.

The SS active controls/features include: 1) a seismically qualified HAW PVV subsystem including backup diesel generator that meets PC-3+ criteria, 2) a HAW Ventilation System, 3) a Fire Suppression System in the HAW Process Room and Cementation Area, 4) temperature/steam controls and interlocks for the LAW evaporator system, 5) steam control and interlock for the HAW evaporator system, and 6) LAW evaporator vent path.

As can been seen in the attached Table 4.3, there are multiple controls used to prevent and/or mitigate each accident. These controls are robust and when required to function during or following a seismic event, are designed to meet PC-3+ criteria. Many of the controls are passive and, therefore, are more reliable than controls based upon active functions. With respect to selection of controls closest to the hazard, the ventilation system closest to the HAW is the SS PVV subsystem. The ventilation system next closest to the HAW is the SS HAW Ventilation System. The HAW process vessels and piping are seismically qualified to provide primary confinement, the HAW Process Area has seismically qualified fire barriers to provide secondary confinement, and the WSB building structure is seismically qualified to provide tertiary confinement. Note that these layers of confinements are not credited to provide a reduction in leak path factor for the unmitigated accident scenarios, but are credited with performing a confinement function for mitigated scenarios where appropriate, e.g. HAW process vessels contain HAW during a seismic event preventing its release/spill, but are not credited with preventing a spill from normal operations. The HAW Process Room is credited as a Defense in Depth (DID) feature for certain scenarios, but is not credited as providing primary confinement nor is LPF factor reduction applied in any scenarios.

While not required based upon the dose consequences in the safety analysis accident scenarios, the HAW glovebox/enclosure ventilation systems are classified as SS to provide additional protection for the facility worker. The MAR in these systems is small enough that no dose consequences to the co-located worker exceed 100 rem for any accident scenario. The enclosures themselves are functionally classified as SS to protect the facility worker from spills/splashing and the enclosure ventilation systems protect other facility workers following the spill. These systems include the HAW Cementation Enclosure Ventilation System, the HAW Sample Glovebox Ventilation System and the Laboratory Glovebox Ventilation System. Since the functional classification for these systems exceeds minimum classification requirements for these systems, no additional discussion is provided.

2.3 Summary

The WSB PDSA and CHA did identify one design basis events that challenge the offsite Evaluation Guideline contained in DOE-STD-3009-94. The PDSA and CHA identify several design basis events included in the DSA that exceed the SS criteria for co-located and facility workers. The safety features credited provide protection that meets or exceeds the requirements in DOE-STD-3009-94. Based on these results, the WSB evaluation team believes that the safety strategy described in Attachment 1, Table 4.3, is prudent, cost effective and provides appropriate protection to the public, co-located worker and facility worker.

3.0 System Evaluation

3.1 Identification of Gaps

A data collection table (see Table 4.3 in Attachment 1), as discussed in Section 2.2, was developed based on the Reference 5 evaluation guidance in response to DNFSB Recommendation 2004-2 (Reference 7). This table and the functional classification strategy in Section 2 allow for independent assessment of the WSB safety design strategy. Using this information, an assessment was performed in accordance with Reference 5 guidance to evaluate the credited features of the WSB ACVS in accordance with the SC performance criteria and to identify any gaps between the criteria and the design. The results of the evaluation are documented in Attachment 3, Table 5.1. This table is labeled as Table 5.1, System Evaluation, the same number and title as that given in Reference 5.

3.2 Gap Evaluation

A gap exists between the design of the ACVS SS subsystems (HAW PVV and HAW Ventilation) and SC single-failure criterion. The SS portion of the electrical distribution system, which provides power to the ACVS SS subsystems, does not meet the SC single-failure criterion, as defined in DOE O 420.1B (Reference 8) and DOE G 420-1.1 (Reference 9). DOE G 420.1-1 requires SC electrical systems to meet several IEEE standards which the electrical distribution system is not designed to meet.

3.3 Modifications and Upgrades

The gap was reviewed and a modification of the existing ACVS and supporting electrical distribution system design to close the gap was developed. The modification was developed to a pre-conceptual level of detail and is summarized below:

Safety Class Redesign

The facility modification is a redesign of the ACVS including the SS HAW PVV and HAW Ventilation subsystems to comply with SC requirements, PC-3+ seismic criteria and PC-3 criteria for other NPH events. The design modification would provide a SC ACVS and SC filtration with dedicated diesel generators located in a separate PC-3+ qualified structure. The electrical distribution system would be designed to SC standards and comply with the requirements in DOE O 420.1B, DOE G 420-1.1 and applicable IEEE standards.

The rough order of magnitude estimate for design and construction of this facility modification is $35 to $50 million. The estimate does not include additional lifecycle cost associated with operations and testing.

4.0 Conclusion

The PDSA and CHA did identify one design basis events that challenge the offsite Evaluation Guideline contained in DOE-STD-3009-94. The PDSA and CHA identify several design basis events that exceed the SS criteria for co-located and facility workers. The safety features credited provide protection that meets or exceeds the requirements in DOE-STD-3009-94. The facility design provides sufficient passive and active features to prevent and mitigate the consequences well below the worker criteria or the ventilation evaluation criteria of 1 rem to an offsite individual. Due to the measures taken to prevent releases of HAW material, there is no discernable benefit from elevating the functional classification of the WSB ACVS to SC.

References

1. WSRC-SA-2003-00002, "Waste Solidification Building Preliminary Documented Safety Analysis", Rev. 1, February 2009.
2. WSRC-TR-2007-00134, "Consolidated Hazards Analysis for the Waste Solidification Building (WSB)", Revision 2, February 2009.
3. DOE-STD-3009-94, Change Notice No. 3, "Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Safety Analysis Reports", March 2006.
4. WSRC Manual E7, "Conduct of Engineering and Technical Support", Procedure 2.25, "Functional Classifications", Rev 15, June 2007.
5. DOE Guide, "Ventilation System Evaluation Guidance for Safety-Related and Non-Safety-Related Systems", Revision 0, January 2006.
6. DOE-HDBK-3010-94, Volume 1, Change Notice 1, "Airborne Release Fractions/Rates and Respirable Fractions for Non-Reactor Nuclear Facilities", March 2000.
7. DNFSB Letter, J. T. Conway to DOE Secretary Spencer Abraham, "Recommendation 2004-2, Active Confinement Systems", December, 7 2004.
8. DOE O 420.1B, "Facility Safety", December 22, 2005.
9. DOE G 420-1.1, "Non-Reactor Nuclear Safety Design Criteria and Explosives Safety Criteria for use with DOE O 420.1, Facility Safety", March 28, 2000.

Attachment 1 – 2004-2 Ventilation System Evaluation Guide Table 4.3, Confinement Documented Safety Analysis Information

The attached Table 4.3 is a summary taken from the Preliminary Documented Safety Analysis (PDSA) and the Consolidated Hazards Analysis (CHA).

The unmitigated dose values provided are best estimates based on unit dose calculations and ARF*RF values selected from DOE-HDBK-3010-94. The estimates are based on preliminary calculations. The unit dose is based on a surface roughness length of 100 cm and 95% meteorology for offsite receptor and 50% meteorology for co-located worker. The mitigated dose is a qualitative assessment based on typical performance criteria for mitigative controls and results from previous calculations for similar events. Mitigated dose to the MOI takes credit for the mitigation provided by the Safety Significant controls for the co-located worker. Additional detailed analysis is required to established quantitative values. Below is the definition of the qualitative values as used in this table:

Dose Level High – A radiological consequence level, for the Offsite receptor, greater than 25.0 rem or a radiological consequence level, for the Facility Worker (FW) and Co-located Worker (CW), greater than 100 rem.

Dose Level Moderate (Mod.) - A radiological consequence level, for the Offsite receptor, between 5.0 to 25.0 rem or a radiological consequence level, for the Facility Worker (FW) and Co-located Worker (CW), between 25 to 100 rem.

Dose Level Low - A radiological consequence level, for the Offsite receptor, between 0.5 to 5.0 rem or a radiological consequence level, for the Facility Worker (FW) and Co-located Worker (CW), between 5.0 to 25 rem.

Dose Level Negligible (Neg.) - A radiological consequence level, for the Offsite receptor, is less than 0.5 rem or a radiological consequence level, for the Facility Worker (FW) and Co-located Worker (CW), is less than 5.0 rem.

DNFSB 2004-2 Ventilation System Evaluation Guide Table 4.3 Confinement Documented Safety Analysis Information											
Facility Waste Solidification Building			**Hazard Category 2**					**Performance Expectations**			
Bounding Accidents	**Type Confinement**		**Doses**		**Confinement Classification**			**Function**	**Functional Requirements**	**Performance Criteria**	**Compensatory Measures**
	Active	**Passive**	**Unmitigated (LPF is 1)**	**Mitigated**	**SC**	**SS**	**DID**				
HAW Evaporator Red Oil Explosion (Not initiated by seismic event)	None credited **Note 1**	None credited	MOI – High (120 rem) CW – High (33,000 rem)	No release				The HAW evaporator high temperature interlock and vent path prevent conditions necessary for a red oil explosion to occur in the HAW evaporator.	The HAW evaporator high temperature interlock and vent path prevent the evaporator from reaching the temperature required for rapid decomposition of TBP.	The HAW evaporator high temperature interlock system prevents the evaporator temperature from exceeding 130°C. The HAW evaporator vent path provides sufficient vent area to limit pressurization in the evaporator such that the contents will not reach the red oil explosion autocatalytic temperature.	None

DNFSB 2004-2 Ventilation System Evaluation Guide Table 4.3
Confinement Documented Safety Analysis Information

Facility Waste Solidification Building					Hazard Category 2				Performance Expectations		
	Type Confinement		Doses		Confinement Classification						
Bounding Accidents	Active	Passive	Unmitigated (LPF is 1)	Mitigated	SC	SS	DID	Function	Functional Requirements	Performance Criteria	Compensatory Measures
Fire – High Activity Process Room Fire causes boiling release of HAW process vessel contents. (Not initiated by seismic event)	None credited.	HAW Process Vessels	MOI - Moderate (7.3 rem) CW – High (2,000 rem)	MOI – Negligible CW – Negligible		**Note 2** HAW Process Vessels Contain HAW **Note 3**		The Fire Suppression System limits the intensity of the fire and prevents the solution in the process vessels from boiling.	Stainless steel HAW process vessels contain the HAW preventing release into the room. The fire suppression system suppresses the fire keeping the contents of the process vessels from boiling.	Vessels provide containment for the HAW material. Fire suppression system per NFPA requirements provides water flow/coverage to suppress/ extinguish fire.	None
Piping Leak/Spill Inside High Activity Process Room (Not initiated by seismic event)	High activity process room exhaust and HEPA filtration.	High activity process room structure and liner.	MOI – Low (2.1 rem) CW – High (558 rem)	MOI – Negligible CW – Negligible		High activity process room exhaust and HEPA filtration. High activity process room structure and liner. **Note 4**		Confinement for co-located and facility worker protection.	Passive room structure and liner contains spill in limited area. Process Room Exhaust and HEPA provides filtration.	Passive room structure and liner contains spill in limited area. Process Room Exhaust HEPA filter efficiency of 99.5%.	None

DNFSB 2004-2 Ventilation System Evaluation Guide Table 4.3
Confinement Documented Safety Analysis Information

Facility Waste Solidification Building					Hazard Category 2				Performance Expectations		
Bounding Accidents	**Type Confinement**		**Doses**		**Confinement Classification**			**Function**	**Functional Requirements**	**Performance Criteria**	**Compensatory Measures**
	Active	**Passive**	**Unmitigated (LPF is 1)**	**Mitigated**	**SC**	**SS**	**DID**				
High Activity Process Vessel Hydrogen Explosion	High activity process room exhaust and HEPA filtration.	High activity process room structure and liner.	MOI – Moderate (4.1 rem) CW – High (1080 rem)	No release		**Note 5**	High activity process room exhaust and HEPA filtration. High activity process room structure and liner.	The HAW PVV subsystem dilutes the hydrogen gas generated by radiolysis of vessel solution. The dilution prevents the explosion. The high activity process room structure, exhaust, and filtration serves as a DID feature to confine spill material to protect the co-locate worker if preventive features fail.	Passive room structure and liner contains spill in limited area. Process room Exhaust and HEPA provides filtration.	Passive Room structure and liner contains spill in limited area. Process Room Exhaust HEPA filter maintains an efficiency of 99.5%.	None
Nuclear Criticality	**Note 6**										

DNFSB 2004-2 Ventilation System Evaluation Guide Table 4.3 Confinement Documented Safety Analysis Information											
Facility Waste Solidification Building				**Hazard Category 2**				**Performance Expectations**			
Bounding Accidents	**Type Confinement**		**Doses**		**Confinement Classification**			**Function**	**Functional Requirements**	**Performance Criteria**	**Compensatory Measures**
	Active	**Passive**	**Unmitigated (LPF is 1)**	**Mitigated**	**SC**	**SS**	**DID**				
Natural Phenomena (Seismic – Spill) (All HAW and LAW vessels filled to capacity) **Note 7**		High activity tanks, vessels and piping. Building structure prevents damage to the high activity tanks, vessels and piping from failure of overhead structure and components.	MOI – Low (0.6 rem) CW – High (150 rem)	MOI – Negligible CW – Negligible **Note 8**		High activity tanks, vessels and piping. **Note 9** Building structure		Confinement for Co-located worker protection	Passive tanks, vessels, and piping preclude spills of high activity solution following a seismic event. Building structure prevents impacts from overhead structure and components (2 over 1).	Passive tanks, vessels, piping, will contain process solutions following a PC-3 seismic event. Passive building structure will withstand a PC-3 seismic event.	None

Notes

1. The control philosophy described in DNFSB Tech 33 Report for control of red oil explosions was applied in the selection of controls. Five controls were selected, which when combined, are sufficiently robust to prevent a red oil explosion. Three of the controls are engineered controls that prevent the conditions necessary for decomposition of TBP in the HAW Evaporator. The first SC control is the HAW evaporator high temperature interlock system which prevents the temperature of the evaporator contents from exceeding the initiation temperature for a runaway red oil reaction. The second SC control is a vent path on the HAW evaporator to prevent the pressure explosion that could occur in unvented or inadequately vented vessels during a red oil reaction. Sufficient venting also has the added benefit of allowing the solution to self cool by evaporative heat transfer thus allowing the reaction rate of the TBP decomposition reaction to decrease, thereby preventing the red oil explosion. The third SS defense in depth control is an evaporator high steam pressure interlock system to prevent the steam coil pressure from exceeding a value that could result in a high evaporator temperature. An AC requiring sampling of the HAW evaporator head tank contents prior to evaporation was also selected to provide a SC function to protect the organic content assumptions used to size the vent path. This ensures that accumulation of TBP received in the MFFF HAW stream or transferred from the LAW process via LAW evaporator overheads in the evaporator head tank will be detected. In addition, the WAC Program requiring that the organic content in the waste received from the MFFF is limited to trace quantities was selected as defense in depth SS function. In a similar fashion, the red oil explosion is prevented in the LAW evaporator by a set of SS controls.
2. The Fire Suppression System mitigates the fire event by extinguishing or limiting the magnitude of the potential fire. This feature is classified SS because the unmitigated consequences for this event exceeded the DOE-STD-3009-94 SS criteria for the FW and CW. The Fire Suppression System is designated SS.
3. The structure around the HAW Process Area serves as a safety significant fire barrier to prevent fire propagation between HAW Process Area and the rest of the facility.
4. The unmitigated consequences of significant spills of HAW liquid are high to workers located inside the facility. The Safety Significant HAW process room ventilation provides mitigation by confining any airborne material to the process area and preventing uptake by any facility worker outside the immediate area of the release.
5. The event is prevented by the HAW PVV subsystem. The process vessel vent pulls air into the process vessels for dilution of the hydrogen gas generated. The HAW PVV subsystem is classified SS because the consequences for this event exceeded the DOE-STD-3009-94 SS criteria for the FW and CW. The system is designated SS and designed to exceed PC-3 criteria.
6. There is no credible criticality scenario in the WSB.
7. Due to the design of the HAW system components and HAW Process Room, a seismic event could not result in a fire that would expose the material at risk. The design features of the HAW Process Room and equipment preclude an incipient fire caused by a seismic event to propagate or become significant enough to boil a tank of solution. Therefore, a fire following a seismic event is not considered a WSB DBA.
8. For seismic and tornado events, the mitigated dose is a result of spilling the material contained outside of the HAW process vessels and piping. The material contained outside of the HAW process includes low activity, laboratory, and job waste inventories.
9. The seismically induced spill/leak event is prevented. The building structure and high activity tanks, vessels, and piping are designed to meet PC-3+ criteria. They are classified SS because the consequences for this event exceeded the DOE-STD-3009-94 SS criteria. The HAW PVV subsystem and backup diesel generator are designed to meet PC-3+ seismic criteria and credited to remain operational during and following a design basis seismic event.

Attachment 2 – Safety Analysis Approach and Plan

Attachment 2 is provided to demonstrate the conservative approach of the safety analysis for the events with consequences below the offsite evaluation guide. Since the red oil explosion exceeds the offsite evaluation guide, the methodology for red oil explosion is not described in this attachment. All consequence calculations are based on 95% meteorology and 100 cm surface roughness factors for the offsite receptors and 50% meteorology and 100 cm surface roughness factors for the CW at 100m. Fire releases are assumed to have 20-minute duration, all other events are assumed to have release duration of 3-minutes.

Fire Analysis

Due to the separation of the HAW Process Area from the rest of the facility by a fire barrier seismically qualified to meet PC-3+ criteria, the unmitigated fire analysis is based on two scenarios. The first is a fire inside the fire area containing the HAW Process Area and the second is a fire involving the remainder of the facility.

Unmitigated fire consequences are calculated based on bounding inventories provided in the WSB Safety Basis Strategy. The entire HAW inventory (18 kg Am-241+ other nuclides in the distribution) is assumed to be involved in the HAW Process Room fire. The entire LAW inventory, plus a limited quantity of HAW solution in the laboratory, and HAW Cementation Area are assumed to be involved in the fire in the remainder of the facility.

For the fire in the HAW Process Area, a bounding ARF*RF was applied for vigorous boiling solutions from DOE-HDBK-3010-94. Additionally, an alternate strategy of calculating the unmitigated fire consequences based on a conservatively bounding estimate of available (installed and transient) combustibles to determine the amount of heat energy that is imparted to the liquid was performed and gave approximately the same result as the boiling solution methodology.

For the fire in the remainder of the facility, it is also assumed that bulk liquids (i.e. the LAW inventory) are heated to vigorous boiling. The same ARF*RF factor as the HAW process area fire is applied.

A fire in the HAW Process Area has been identified as an event with the potential to result in significant consequences to the co-located worker.

The HAW Process Area has limited personnel access and is designed with a low combustible loading. The most likely initiator for a fire large enough to release any radiological inventory from the HAW process vessels is postulated to occur during maintenance on equipment in the HAW Process Room. Plastic sheeting and other transient combustibles would likely be required for contamination control during maintenance activities on pipe or tank components in the HAW Process Room. This material could be ignited by hot work or other ignition sources in the HAW process room including electrical shorts, or embers sucked into the facility from an external fire.

Fires could also be initiated during normal operations (e.g., electrical shorts on lighting, motors, etc.). It is unlikely that such a fire would have sufficient intensity due to the designed low combustible loading to result in a significant radiological release and is bounded by the fire postulated to occur during maintenance when transient combustibles could be introduced into the HAW Process Room.

In order to mitigate this scenario, a Safety Significant (non-seismic) Fire Suppression System has been selected to extinguish or limit the intensity of potential fires and prevent a boiling release of solution. The Safety Significant stainless steel HAW process vessels contain the HAW material and are unaffected by the fire or the activation of the fire suppression system.

Fires in other areas of the facilities do not challenge the evaluation guidelines to the CW due to limited inventory outside of the HAW Process Area. Inventory limits for the Laboratory and HAW Cementation Areas will be established and protected.

Hydrogen Explosion Analysis

Explosions may occur in HAW process vessels or fluidic pump charge vessels due to the accumulation of hydrogen from radiolysis.

Unmitigated consequence analysis for hydrogen explosions are based on a TNT equivalent model in which a source term is derived based on the energy generated when the headspace of the vessel in question is ignited while containing a stoichiometric mixture of hydrogen and air. The concentration of radionuclides in the solution is based on the bounding concentration of 2 g/liter Am-241 expected to be in the HAW process. Composite dose factors calculated for the HAW stream in terms of rem per Americium curie using the MACCS computer code are applied to the source term to determine the dose.

Explosions in the HAW vessels and evaporator have been identified as events with the potential to result in significant consequences to the co-located worker. The HAW tanks contain transuranic radionuclides dissolved in an aqueous nitric acid solution. Hydrogen is produced through radiolytic decomposition of hydrogenous material (i.e., water) within the HAW process vessels. Due to the high concentrations of alpha emitting radionuclides, hydrogen is abundantly produced. On a loss of flow through the HAW PVV subsystem, hydrogen can reach the LFL under worst case conditions in several hours. A loss of power to the HAW PVV subsystem exhaust fans or operator error (e.g., inadvertently secure HAW PVV subsystem exhaust flow) are the more likely causes for losing HAW PVV subsystem flow. Other initiators could be mechanical failure of fans, line breaks, etc. Once above the LFL, an ignition source from either static or electrical shorts could ignite the flammable gas leading to a deflagration or detonation.

A decision was made to credit the HAW PVV subsystem as a preventive engineered feature to prevent hydrogen explosions by providing a continuous flow of dilution air through the vessels. The HAW PVV subsystem is constructed with dual fan/HEPA trains separated by a fire barrier with separate electrical feeds and back-up diesel power such that a single event will not disable the system. In addition, there is an external connection so that if necessary an auxiliary portable fan/HEPA unit may be connected external to the building as a response/recovery action. Time to LFL calculations are developed to determine minimum dilution flow rates based on the final configuration of the vessels and include any other constituents (e.g. ammonia, organics) that may arrive as impurities in the waste stream in addition to hydrogen that would contribute to the composite LFL.

Spill Analysis

The potential exists to spill solution from the HAW process vessels or piping. Unmitigated consequence analysis is based on a catastrophic failure of the transfer piping at the highest point in the HAW Process Room (30 foot elevation) resulting in the entire contents of the HAW vessel falling to the HAW floor from the failed piping.. The inventory of an individual vessel is assumed to be 6 kg of Am-241 plus other nuclides as provided in the WSB Safety Basis Strategy. The ARF*RF values were calculated using the methodology in DOE-HDBK-3010-94 based on a fall distance of 30 feet. This scenario bounds spills from other locations in the facility due to the bounding height and inventory associated with this spill.

Conservatisms in this scenario include the release quantity, the release elevation, the scenario selected for the process room spill, etc. The piping above the vessel is welded construction and has no valves at the higher elevations. No credit is taken for operator response to area radiation alarms or tank level indication which would initiate a response action, stopping the transfer, prior to spilling the entire tank contents. The leak is assumed to be catastrophic resulting in the release of the entire tank contents with no warning vs. a more realistic scenario involving only a fraction of the transfer volume. The failure is assumed to be at the highest point physically possible in the HAW Process Room while only a small fraction (if any) of the HAW process piping would be expected to be at that elevation. Note that a tank leak at an elevation consistent with the vessel leaking (3 meters) would result in dose consequences to the MOI below 1 rem.

This spill scenario was identified as having the potential for significant consequences to the CW and FW. The HAW Ventilation System is credited providing confinement and filtration of any releases. Mitigated consequences are calculated by applying the decontamination factor of the credited HEPAs to the previously calculated unmitigated consequences.

Aircraft Crash Analysis

The crash of helicopters or general aviation aircraft was identified as an event with the potential for significant consequences to the CW in the hazards analysis. Further analysis indicates that it is not credible for an aircraft to strike the fire area containing the HAW Process Room or for a fire initiated by a crash into the remainder of the WSB to defeat the fire barrier surrounding the HAW Process Area and involve the material there. This scenario defines the unmitigated event. The inventory outside the HAW Process Area is assumed to be limited such that the evaluation criterion for the CW is not challenged. Consequences are calculated based on a fire release from the affected areas in the same fashion as the fire event discussed above.

Seismic Event Analysis

Unmitigated consequences for a seismic event are based on a hydrogen explosion in the HAW process area and a propagated fire involving the LAW, laboratory, and cementation area inventories. Hydrogen is conservatively assumed to accumulate for 14 days and reach the stoichiometric hydrogen to air mixture. The contribution from the hydrogen explosion in a HAW process area is calculated as discussed above. For the fire portion of the release, it is assumed that bulk liquids (i.e. the LAW inventory) are heated to boiling and that smaller volumes (HAW cementation and Lab inventories) are boiled to dryness. The appropriate ARF*RF factors are applied from DOE-HDBK-3010-94.

The WSB structure, HAW process vessels and HAW piping are designed to meet PC-3+ criteria. Therefore, the building structure, process vessels and piping remain intact during and after the design basis seismic event.

Because the HAW process vessels are credited with surviving the seismic event, and it is postulated HAW PVV subsystem fails due to a loss of power and/or damage incurred from the seismic event. This allows hydrogen generated by radiolytic decomposition of the aqueous solution in the HAW process solution tanks to begin to accumulate. Under worst case conditions, the hydrogen level in a HAW vessel can exceed the LFL in several hours. Additionally, a fire starts in either a maintenance area or laboratory area due to the presence of flammable materials and a relatively high combustible loading. A post seismic fire is not postulated in areas designed with low combustible loads and isolated by seismically qualified fire barriers such as the HAW Process Area.

In order to prevent the build-up of hydrogen in vessels that could lead to an explosion, the HAW PVV subsystem is seismically qualified to meet PC-3+ criteria, provided with diesel backup power, and consists of two separate fan/HEPA trains separated by a fire barrier to ensure that it remains functional following the design basis seismic event and any potential post seismic fire in the remainder of the facility. The mitigated consequences therefore are based only on a spill and fire involving the inventory outside of the HAW Process Area, which will be limited to levels that will not challenge the evaluation criteria.

Attachment 3 – 2004-2 Ventilation System Evaluation Guide Table 5.1, System Evaluation

Evaluation Criteria	Discussion	Reference
	1 – Ventilation System – General Criteria	
Pressure differential should be maintained between zones and atmosphere (Discussion: Number of zones as credited by accident analysis to control hazardous material release; demonstrate by use considering potential in-leakage)	The Waste Solidification Building (WSB) Active Confinement Ventilation System (ACVS) provides a confinement ventilation function within the WSB to minimize the spread of radioactive contamination, maintain personnel exposure ALARA and prevent release of radioactive contaminates to the public and environment. The ACVS is designed with three confinement zones – primary, secondary, and tertiary and employs a once through design that maintains an airflow that moves in the direction of higher contamination potentials, prior to filtering. Confinement Zones • Primary Zone - HAW and LAW process vessels, cementation drums and cementation enclosures as well as the gloveboxes (HAW sample and laboratory) • Secondary Zone – HAW and LAW process and cementation areas, laboratory area and hoods, HEPA filter rooms, and hot maintenance room • Tertiary Zone – fan room, TRU Solid Waste room, support spaces, air locks, and corridors The primary zone is served by the HAW and LAW Process Vessel Vent (PVV) subsystems for process vessels and the cementation drums and by the HAW Ventilation System for the HAW and LAW cementation enclosures, the HAW sample glovebox, and the laboratory glovebox. The secondary zone is served by the HAW Ventilation System for HAW Process Room and by the Building Exhaust System for the LAW Process Room, cementation area, laboratory area, HEPA filter rooms, job solid waste processing room and hot maintenance room. The tertiary zone is served by the Building Exhaust System. The ACVS is designed to comply with the requirements specified in SRS Engineering Standard 15889, Confinement Ventilation Systems Design Criteria. Standard 15889 provides for differential pressure ranges that shall be maintained between confinement zones. The HAW PVV and HAW Ventilation Systems are credited as Safety Significant (SS) for worker protection. The primary confinement zone for the HAW process vessels is credited in the HAW process room fire event. The Fire Suppression System limits the intensity of the fire and prevents the solution in the process vessels from	DOE-HDBK-1169 (2.2.9) ASHRAE Design Guide

Evaluation Criteria	Discussion	Reference
	boiling. The HAW PVV subsystem provides confinement of any material that may be volatized prior to activation of the Fire Suppression System. The HAW PVV filtration equipment and exhaust fans are separated from the HAW Process Area by a seismically qualified fire barrier. The HAW PVV subsystem is designed to function following all design basis events including NPH and fires. The secondary confinement zone for the HAW Process Room is credited in the spill/leak event inside the HAW Process Room. The process room walls and stainless steel liner act to confine the spilled liquid in the immediate area and the HAW Process Room Ventilation subsystem provides confinement of any airborne material in the HAW Process Room protecting the facility workers outside of the process room. The confinement zones are not credited controls for the HAW process vessel hydrogen explosion events. The HAW PVV subsystem prevents the hydrogen explosion by providing dilution air to the process vessels. The secondary confinement zone does provide a defense in depth feature for the explosion events. The HAW Process Room Ventilation subsystem provides confinement of any airborne material in the HAW Process Room protecting the facility workers outside of the process room. The HAW Ventilation System filtration equipment and exhaust fans are separated from the HAW Process Area by a reinforced concrete fire barrier. The confinement zones are not credited controls for seismic or tornado events. The WSB building structure and the seismically qualified process vessels, and piping prevent the release of material. The post seismic hydrogen explosion is prevented by the HAW PVV subsystem. The HAW PVV subsystem is designed to function following the design basis seismic event to provide dilution air to the process vessels. The design basis seismic event does not result in a fire that would expose the material at risk. The HAW process rooms are steel lined, and the HAW Process Area is isolated by a seismically qualified fire barrier. The HAW Process Area design minimizes and protects fixed combustible loading. <u>Standards</u> WSRC-TM-95-1, SRS Engineering Standard No 15889, Confinement Ventilation Systems Design Criteria. <u>References</u> G-FDD-F-00007, Facility Design Description for Waste Solidification Building. M-SYD-F-00055, WSB System Design Description for HVAC System. M-M5-F-2865, WSB Process Area and Lab Modules Air Flow Diagram <u>Gap Analysis</u> The differential pressures are maintained between zones and atmosphere during normal operations. The PVV	

Evaluation Criteria	Discussion	Reference
	system is designed to function following all design basis events and expected to maintain a differential pressure between the HAW process vessels and the atmosphere. The accident analysis does not require the HAW Ventilation or Building Exhaust Systems to function following NPH or fire events. No gaps identified.	
Materials of construction should be appropriate for normal, abnormal, and accident conditions.	Materials of construction in the design for the ACVS include stainless steel and galvanized carbon steel. The HVAC System Design Description (SDD) requires ductwork for all potentially contaminated HVAC exhaust systems to be welded construction with flanged transverse joints and fabricated from Type 304L stainless steel sheet metal or pipe. Stainless steel construction is utilized for the PVV, glovebox, hood, process area exhaust to the building HEPA filters and HAW Process Room supply ductwork. Galvanized carbon steel construction is utilized for most of the supply ducts, the main facility exhaust from the building HEPA to stack, and transfer ducts between support rooms. The fans are carbon steel with epoxy coating. The Fire Hazards Analysis requires fire dampers or approved alternative methods (duct insulation) to be designed per NFPA 221 and be consistent with the fire rating of the firewall in which they are mounted. The design includes a fire wrap on the HAW process room exhaust duct to the first HEPA filter. The HVAC SDD invokes SRS Engineering Standard 15888 for HEPA filters. Standard 15888 requires procurement of "fire resistant" filters. The HVAC SDD requires HEPA filter design to meet additional fire protection standards. The ACVS has been designed to meet these requirements. <u>Standards</u> WSRC-TM-95-1, SRS Engineering Standard No 15889, Confinement Ventilation Systems Design Criteria. WSRC-TM-95-1, SRS Engineering Standard No 15888, HEPA Filter Requirements. NFPA 801, Standard for Fire Protection for Facilities Handling Radioactive Materials NFPA 90B, Standard for the Installation of Warm Air Heating and Air Conditioning Systems NFPA 101, Life Safety Code NFPA 221, Standard for High Challenge Fire Walls, Fire Walls, and Fire Barrier Walls. <u>References</u> G-FDD-F-00007, Facility Design Description for Waste Solidification Building. M-SYD-F-00055, WSB System Design Description for HVAC System. M-M5-F-2865, Process Area and Lab Modules Air Flow Diagram F-FHA-F-00033, WSB Project Fire Hazards Analysis	ASME AG-1 DOE-HDBK-1169 (2.2.1)

Evaluation Criteria	Discussion	Reference
	<u>Gap Analysis</u> No gaps identified.	
Exhaust system should withstand anticipated normal, abnormal, and accident system conditions and maintain confinement integrity. (Discussion – As required by accident analysis to prevent accident release)	The HAW and the LAW PVV subsystems serve as the primary confinement ventilation system whose purpose is to provide filtration of airborne hazardous material from their respective process vessels of the WSB. The HAW PVV also maintains HAW vessel flammable gas concentrations below 25% of the Lower Flammability Limit (LFL) limit by providing sufficient air flow. Each vessel has a connection from a vessel nozzle to the HAW or LAW PVV subsystem. Each cementation drum is connected to a PVV line at the drum station inside the cementation enclosure. Two dedicated independent and seismically qualified exhaust fans are provided for the PVV System, one running and one in automatic standby, to pull a continuous air flow (dilution) on each subsystem. The PVV System maintains a minimum differential pressure between each tank and room on all WSB process vessels. This differential pressure provides a minimum dilution flow through the vapor space of each vessel from dual HEPA filtered air connections. All of the HAW vessels exhaust into a common stainless steel welded header. Similarly, all of the LAW vessels exhaust into a common stainless steel welded header. The air flows through the headers and passes through respective HAW and LAW condensers and demisters. The collected condensate for the HAW PVV is returned back to the Acid Overflow Tank. The collected condensate from the LAW PVV is returned to the HAW Condensate Tank. The air that leaves the demisters is heated above the dew point. The air is then exhausted through HEPA filters and the exhaust fans. The HAW PVV is exhausted into the main process area exhaust just prior to the exhaust stack. The LAW PVV is exhausted into the main process area header upstream of the main HEPA filters The HAW PVV subsystem is designed to be qualified to meet PC-3+ seismic criteria and PC-3 criteria for other NPH events in accordance with the PDSA, to have dual independent trains (with a common emergency diesel backup power) and to meet NFPA requirements including a seismically qualified fire barrier between trains. Each train is within a separate fire zone. In the event both exhaust fans become inoperable, backup exhaust capabilities can be provided through a connection in the external WSB wall. The fans and primary control and monitoring equipment are inside the process room fire barrier in a separate room from the process vessels. A Safety Integrity Level (SIL) evaluation of the HAW PVV subsystem's Safety Significant Instrumented System (SSIS) was performed per SRS Standard 01703. The Layer of Protection Analysis (LOPA) was used with a goal frequency of 10^{-4}. Two SSIS are required to ensure dilution flow to the HAW PVV subsystem process vessels. One HAW PVV subsystem SSIS acts to keep suction on the system (by bringing on the backup fan) and the other SSIS assures that the flow path is not blocked (by alarming and having a changeover to another filter). The SSIS, to assure suction is kept on the exhaust, will need to be designed to a minimum of a SIL-2 level. The SSIS to	DOE-HDBK-1169 (2.4) ASHRAE Design Guide

Evaluation Criteria	Discussion	Reference
	assure that the flow path is open will need to be designed to a minimum SIL-1 level. The HAW Ventilation System includes ventilation for the HAW Process Room, the HAW sample glovebox, the HAW and LAW Cementation Area enclosures, and the laboratory glovebox. Each of these rooms, enclosures and gloveboxes has its own HEPA filters, but all systems are exhausted by the same set of fans that exhaust to the stack. The HAW Process Room Ventilation subsystem provides filtration of airborne hazardous material in the event of a spill or explosion in the HAW Process Room. The exhaust from the HAW Process Room Ventilation subsystem passes through dedicated HEPA filtration before being vented through the stack. Because seismically qualified HAW process equipment is credited for containment during NPH events, the components in the HAW Process Room Ventilation subsystem are not required to remain operational following a seismic event. Components in the HAW Process Room Ventilation subsystem from the process room up to and including the first HEPA filter are seismically-rated for position retention and would continue to serve a confinement function following the event. The HAW Process Room ventilation air is exhausted through two-stages of HEPA filters. Three rows of HEPA filters are provided such that two HEPA rows are operating while the third is in standby for change-out in case of a problem with the operating HEPA set. Two direct drive fans installed in parallel provide motive force for the exhaust. The diesel generator provides back-up power in the event of the loss of normal power. The PVV System ventilation rooms, HAW sample room, maintenance area, personnel and electrical rooms, and cementation area are exhausted through the Building Exhaust System. This system has an operating exhaust fan and a back-up with contain HEPA filters located on the suction side of the fans. The fan discharge is connected to a stack for dispersing the exhaust to the environment. Airlocks are located as needed throughout the WSB to separate radiological areas and prevent the spread of contamination. The airlocks allow the ventilation system to maintain a lower pressure in rooms that most likely contain higher levels of contamination. <u>Standards</u> WSRC-TM-95-1, SRS Engineering Standard No 15889, Confinement Ventilation Systems Design Criteria. WSRC-TM-95-1, SRS Engineering Standard No. 01703, Application of ISA 84.00.01, Part 1 for Non-reactor Facilities. <u>References</u> M-ESR-F-00131, Safety Requirement Specification for the Waste Solidification Building Active Confinement Ventilation System	

Evaluation Criteria	Discussion	Reference
	G-FDD-F-00007, Facility Design Description for Waste Solidification Building M-SYD-F-00055, WSB System Design Description for HVAC System. M-M5-F-2865, WSB Process Area and Laboratory Module Air Flow Diagram <u>Gap Analysis</u> The PVV System and HAW Ventilation System have been design to withstand anticipated normal, abnormal, and accident conditions to maintain confinement integrity as described in the accident analysis. No gaps identified.	
Confinement ventilation systems shall have appropriate filtration to minimize release. (Discussion – Address 1) Type of filter (e.g., HEPA, sand, sintered metal); 2) Filter size (flow capacity and pressure drop); 3) Decontamination Factor vs. accident analysis assumptions)	The WBS design includes HEPA filters on the exhaust from the HAW Process Room, gloveboxes, hoods, Cementation Area, process vessel vent, and the main building exhaust. The HEPA filters are used to remove particulate in the exhaust air. The HAW Ventilation HEPAs are credited by the safety analysis in a spill event with maintaining the process room containment barrier and are designed to remain functional during and following the spill event. The HEPA filter housing and associated ductwork is designed to exceed PC-3 criteria. The HEPA filters capacity is based on the normal exhaust flow rate from the HAW Process Room. It is not anticipated that the filter would experience flows above the normal exhaust flow rate. The PVV Exhaust HEPA filters are functionally classified as safety significant but are not credited in the safety analysis with maintaining a confinement function or minimum filter efficiency. The Building Exhaust HEPA filters are not credited by the safety analysis to be operational or maintain a minimum efficiency. These non-safety significant filters support ALARA goals to control contamination and worker exposure. The HVAC SDD requires the HEPA filters to comply with the SRS Engineering Standard 15888 and 15889. <u>Standards</u> WSRC-TM-95-1, SRS Engineering Standard No 15889, Confinement Ventilation Systems Design Criteria. WSRC-TM-95-1, SRS Engineering Standard No 15888, HEPA Filter Requirements. <u>References</u> M-SYD-F-00055, WSB System Design Description for HVAC System.	ASME AG-1 DOE-HDBK-1169 (2.2.1)

Evaluation Criteria	Discussion	Reference
	M-M5-F-2865, WSB Process Area and Laboratory Module Air Flow Diagram <u>Gap Analysis</u> No gaps identified.	
	2 – Ventilation System – Instrumentation and Control	
Provide system status instrumentation and/or alarms. (Discussion – Address key information to ensure system operability (e.g. system delta-p, filter pressure drop)	The ACVS final design provides both local and remote (control room) indications of system status. The differential pressure (process room (secondary confinement) with respect to the atmosphere) are monitored and controlled by the process control system which adjusts the exhaust fan speed to maintain adequate differential pressure. A standby exhaust fan is brought on-line in the event of low exhaust flow and/or low vacuum on the fan inlet. The differential pressure gages provide means of monitoring secondary confinement areas with respect to tertiary areas. The secondary confinement zones will be manually balanced to achieve the differential pressure with respect to tertiary zones. The exhaust lines within the facility have flow gages to assist with the manual balancing and periodic monitoring of the system. HEPA filters housing are equipped with differential pressure gauge for periodic monitoring. The differential pressure across the building main HEPA filters is monitored by the process control system and alarmed due to low differential pressure. The HVAC SDD requires failure of ventilation instrument equipment to be alarmed in the control room. SRS Engineering Standard 15889 identifies the required confinement system monitoring and controls. The WSB design complies with this standard for system monitoring and controls. <u>Standards</u> WSRC-TM-95-1, SRS Engineering Standard No 15889, Confinement Ventilation Systems Design Criteria. <u>References</u> M-SYD-F-00055, WSB System Design Description for HVAC System. M-M6-F-4172, Process Area Exhaust Air Distribution P&ID. <u>Gap Analysis</u> No gaps identified.	ASME AG-1 DOE-HDBK-1169 ASHRAE Design Guide (Section 4)
Interlock supply and exhaust fans to prevent positive pressure	The WSB final design includes interlocks to shutdown the supply fans if the exhaust fans are not functioning to prevent positive pressure differential. The supply fans for the process and lab areas have been designed to shut down in case both building exhaust fans shut down. Also, the supply fans for the process and lab areas and	DOE-HDBK-1169 ASHRAE

Evaluation Criteria	Discussion	Reference
differential	building exhaust fans are designed to shut down if both process exhaust fans shut down. These interlocks meet the requirements of SRS Engineering Standard 15889. <u>Standards</u> WSRC-TM-95-1, SRS Engineering Standard No 15889, Confinement Ventilation Systems Design Criteria. <u>References</u> M-SYD-F-00055, WSB System Design Description for HVAC System. M-M6-F-4172, Process Area Exhaust Air Distribution P&ID. <u>Gap Analysis</u> No gaps identified.	Design Guide (Section 4)
Post accident indication of filter break-through (Discussion – Instrumentation supports post-accident planning and response; should be considered critical instrumentation for SC)	Radiological monitoring of the WSB exhaust is provided to indicate of filter break-through. The WSB exhaust stack is equipped with an air monitoring and sampling system. The stack monitoring system analyzes the exhaust stream for alpha-beta activity and alarms in the control room if high activity is detected. DNFSB Tech 34 does not specifically address post accident indication of filter break-through. Tech 34 states a concern with having the capability for post accident monitoring and dose assessment for emergency response and planning. These capabilities are provided in the site emergency response and planning. <u>Standards</u> WSRC-TM-95-1, SRS Engineering Standard No 15889, Confinement Ventilation Systems Design Criteria. <u>References</u> M-SYD-F-00055, WSB System Design Description for HVAC System. M-M6-F-4172, Process Area Exhaust Air Distribution P&ID. M-M6-F-4143, Stack Air Activity Monitoring System P&ID. <u>Gap Analysis</u> No gaps identified.	TECH-34
Reliability of control system to maintain confinement function	• Normal and Abnormal Operations The ACVS will be monitored and controlled by the redundant logic solvers. The exhaust fans are	DOE-HDBK-1169 (2.4)

<table>
<tr><th>Evaluation Criteria</th><th>Discussion</th><th>Reference</th></tr>
<tr><td>under normal, abnormal, and accident conditions

(Discussion – Address for example, impacts of potential common mode failures from events that would require active confinement function)</td><td>expected to remain operational except during fan maintenance. The supply and exhaust fan control system is designed to operate automatically from the process control system without operator intervention.

An interlock to shutdown the supply fans when an unacceptable decrease in exhaust system airflow/system pressure will be provided. The detailed logic of the interlocks has been developed.

• Accident Conditions

The SS subsystems of the CVS are not required to provide a confinement function during or after the NPH events. The supply and exhaust fans and logic solvers may or may not survive the NPH events. The HAW Process Room Ventilation is credited for the spill (non-seismic) event in the HAW process room. A spill event in the HAW process room will not impact the CVS control system. Therefore, no common mode failures that would impact the control functions of the credited safety functions.

WSB Process Vessel Vent (PVV)

The HAW PVV subsystem is functionally classified as SS and is designed to meet PC-3+ seismic criteria and PC-3 criteria for other NPH events. The HAW PVV subsystem fans are supplied with back-up power. The redundant logic solvers are used to control the fans.

<u>Standards</u>

WSRC-TM-95-1, SRS Engineering Standard No 15889, Confinement Ventilation Systems Design Criteria.

<u>References</u>

M-SYD-F-00055, WSB System Design Description for HVAC System.
M-M6-F-4172, Process Area Exhaust Air Distribution P&ID.
M-ESR-F-00131, Safety Requirement Specification for WSB Active Confinement Ventilation System.

<u>Gap Analysis</u>

No gaps identified.</td><td></td></tr>
<tr><td>Control components should fail safe</td><td>The safety analysis credits the active function of the HAW PVV to prevent hydrogen explosion and HAW Process Room Ventilation to mitigate the spill event. The controls components fail in a safe position.

The appropriate failure modes were selected so that mechanical/electrical failures will not lead to adverse conditions within the facility</td><td>DOE-HDBK-1169 (2.4)</td></tr>
</table>

Evaluation Criteria	Discussion	Reference
	The PDSA does not credit the function of the WSB Building Exhaust, Air System, and Clean Area HVAC. The controls components for these systems also fail in a safe position. Standards WSRC-TM-95-1, SRS Engineering Standard No 15889, Confinement Ventilation Systems Design Criteria. References M-SYD-F-00055, WSB System Design Description for HVAC System. M-M6-F-4172, Process Area Exhaust Air Distribution P&ID. Gap Analysis No gaps identified.	
	3 – Resistance to Internal Events – Fire	
Confinement ventilation systems should withstand credible fire events and be available to operate and maintain confinement (Discussion – required for new facilities; as required by the accident analysis for existing facilities (discretionary) Must address protection of filter media)	The WSB has a building wide Fire Suppression System with sprinkler heads located in the facility as appropriate per NFPA requirements. The system is a wet-pipe sprinkler system that is supplied water from the F-Area water supply. The sprinkler heads open when the local ambient temperature reaches 155° F and discharges water in the required density and pattern. Based on NFPA 13 Ordinary Hazard Group 1 requirements the heads are designed to apply minimum 0.15 gpm/ft^2 water to the fire. The F-Area water is a NFPA compliant reliable system. The HAW PVV subsystem has dual trains separated by seismically qualified fire barriers so that during and after seismic and fire events, the HAW PVV subsystem will continue to maintain flammable gas concentration below 25% of the LFL by providing a dilution flow and will continue to mitigate the release of airborne hazardous material. The WSB confinement features control the potential release of radioactive material within the building due to a fire event. These passive components are the ductwork from the HAW Process Room to and including the first set of HEPA filters. These components maintain the containment barrier around the HAW Process Room independent of active ventilation exhaust. The final design includes a fire wrap on the HAW Process Room exhaust duct to the first HEPA filter.	DOE-HDBK-1169 (10.1) DOE-STD-1066

Evaluation Criteria	Discussion	Reference
	Standards WSRC-TM-95-1, SRS Engineering Standard No 15889, Confinement Ventilation Systems Design Criteria. WSRC-TM-95-1, SRS Engineering Standard No 15888, HEPA Filter Requirements. NFPA 801, Standard for Fire Protection for Facilities Handling Radioactive Materials NFPA 90B, Standard for the Installation of Warm Air Heating and Air Conditioning Systems NFPA 101, Life Safety Code References G-FDD-F-00007, Facility Design Description for Waste Solidification Building. M-SYD-F-00055, WSB System Design Description for HVAC System. F-FHA-F-00033, Project Fire Hazards Analysis for Waste Solidification Building M-M5-F-2865, Process Area and Lab Modules Air Flow Diagram Gap Analysis No gaps identified.	
Confinement ventilation systems should not propagate spread of fire (Discussion – required for new facilities as required by accident analysis for existing facilities (discretionary) Address fire barriers, fire dampers arrangement)	The HAW Process and Cementation Areas have a seismically qualified 3 hour fire barrier that prevents fire propagation into or out of these areas Additionally, there is a seismically qualified fire barrier around and between the two HAW PVV subsystem trains to prevent fire propagation into or between the duplicate PVV subsystem rooms and SSCs. The HVAC SDD requires fire dampers or approved alternative methods (duct insulation) shall be designed per NFPA 221 and be consistent with the fire rating of the firewall in which they are mounted. During a fire event, the HVAC SDD requires the building supply fans be shutdown while the building exhaust fans continue operating. The final design includes a fire wrap or fire dampers in ductwork when it penetrates fire barriers. The HVAC SDD requires fire dampers or approved alternative methods (duct insulation) shall be designed per NFPA 221 and be consistent with the fire rating of the firewall in which they are mounted. The active portion of the WSB CVS is not credited in the safety analysis with maintaining the confinement integrity during or after a fire event. However, during a fire event, the HVAC SDD requires the building supply fans be shutdown while the building exhaust fans continue operating. Standards	DOE-HDBK-1169 (10.1) DOE-STD-1066

Evaluation Criteria	Discussion	Reference
	WSRC-TM-95-1, SRS Engineering Standard No 15889, Confinement Ventilation Systems Design Criteria. References M-SYD-F-00055, WSB System Design Description for HVAC System. M-M5-F-2865, Process Area and Lab Modules Air Flow Diagram M-M6-F-4172, Process Area Exhaust Air Distribution P&ID Gap Analysis No gaps identified.	
4 – Resistance to Internal Events – Natural Phenomena – Seismic		
Confinement ventilation systems should safely withstand earthquakes (Discussion – 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 confinement ventilation system performance will be based on the current functional requirements in the	The safety analysis credits the building structure and HAW process vessels with maintaining confinement during and following a seismic event. The active portion of the WSB CVS is not credited for a confinement function in the safety analysis during or following a seismic event. The HAW PVV is credited with providing dilution air flow during and following a seismic event. The HAW PVV is designed to meet PC-3+ seismic criteria and PC-3 criteria for other NPH events and is expected to be operational following a seismic event. References G-FDD-F-00007, Facility Design Description for Waste Solidification Building. M-SYD-F-00055, WSB System Design Description for HVAC System. Gap Analysis No gaps identified.	ASME AG-1AA DOE O 420.1B DOE HDBK-1169 (9.2)

Evaluation Criteria	Discussion	Reference
DSA.)		
5 – Resistance to Internal Events – Natural Phenomena – Tornado/Wind		
Confinement ventilation systems should safely withstand tornado depressurization (Discussion – If the active CVS system 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 confinement ventilation system performance will be based on the current functional requirements in the DSA.)	The WSB structure is designed to withstand the impact of a design basis tornado corresponding to the PC-3 criteria. The passive building structure precludes involvement of radiological material within the HAW Process Room in the tornado event. The WSB CVS is not a credited control in the safety analysis for the tornado event. Therefore, the CVS was not evaluated against the criteria. <u>References</u> G-FDD-F-00007, Facility Design Description for Waste Solidification Building. M-SYD-F-00055, WSB System Design Description for HVAC System. <u>Gap Analysis</u> No gaps identified.	DOE O 420.1B DOE HDBK-1169 (9.2)
Confinement ventilation systems should safely withstand wind design effects on system performance (Discussion – If the active CVS system is	The WSB structure is designed to withstand the impact of high winds corresponding to the PC-3 criteria. The passive building structure precludes involvement of radiological material within the HAW Process Room in the tornado event. The WSB structure protects the HAW process vessels from tornado winds and missiles. The WSB CVS is not a credited control in the safety analysis for the high wind event. Therefore, the CVS was not evaluated against the criteria. <u>References</u> G-FDD-F-00007, Facility Design Description for Waste Solidification Building. M-SYD-F-00055, WSB System Design Description for HVAC System.	DOE O 420.1B DOE HDBK-1169 (9.2)

Evaluation Criteria	Discussion	Reference
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 confinement ventilation system performance will be based on the current NP analysis in the DSA.)	<u>Gap Analysis</u> No gaps identified.	
	6 – Other NP Events (e.g., flooding, precipitation)	
Confinement ventilation system should withstand other NP events considered credible in the DSA where the confinement ventilation system is credited. (Discussion – If the active CVS system is not credited this event there is no need to evaluate that performance and/or design attribute for the confinement ventilation system	The other natural phenomena events are evaluated in the safety analysis including floods and lightning. The topography and elevation of the surrounding area precludes flooding from the Upper Three Runs Creek. The calculated water elevation for a 100,000 year return flood at F-Area due to runoff from the Upper Three Runs basis is 145 feet above sea level. The elevation of F-Area is greater than 260 feet above sea level. A lightning strike on the WSB could affect the availability of multiple electrical systems and cause the loss-of-power event. The loss of power event does not result in a release of HAW material. There is also possibility of shorts within the electrical system and initiating of fires. A lightning strike event does not result in a fire that would result in the release of HAW material. The HAW process rooms are steel lined, and the HAW Process Area is isolated by a seismically qualified fire barrier. The HAW Process Area design minimizes and protects fixed combustible loading. The WSB CVS is not a credited control in the safety analysis for the flooding or lightning strikes. Therefore, the CVS was not evaluated against the criteria. <u>References</u> G-FDD-F-00007, Facility Design Description for Waste Solidification Building. M-SYD-F-00055, WSB System Design Description for HVAC System. <u>Gap Analysis</u> No gaps identified.	DOE O 420.1B DOE HDBK-1169 (9.2)

Evaluation Criteria	Discussion	Reference
(discretionary).)		
	7 – Range Fires / Dust Storms	
Administrative controls should be established to protect confinement ventilation systems from barrier threatening events (Discussion – Ensure appropriately through out response to external threat is defined (e.g. pre-fire plan)	A comprehensive wild land fire protection program is developed and implemented for SRS facilities. As part of this, wildfire hazard severity analyses are conducted for existing buildings and facilities or planned site improvements. When the hazard analysis identifies a threat from wildfire, approved plans for the establishment and maintenance of defensible space are established. In addition, Fire Department Operating Standards 2Q2 incorporate a wild land fire procedure. The WSB structure housing the ACVS and associated support systems will be built of noncombustible materials. This combined with a property protection area and minimal vegetation presence within the WSB site prevents wildfire propagation from outside to within the WSB structure. References WSRC-SCD-4, FA 12, Fire Protection Functional Area 12. WSRC-2Q2, Fire Department Operating Standards, Section 6, Wild land Fire Procedure. Gap Analysis No gaps identified.	DOE O 420.1B
	8 – Testability	
Design supports the periodic inspection & testing of filters and housing, and tests and inspections are conducted periodically (Discussion – Ability to test for leakage per intent of N510)	The WSB FDD requires the design provide for periodic inspection and testing of equipment. The HVAC SDD requires the ventilation design be compliant with SRS Engineering Standard 15888 and 15889. These standards require the ventilation design provide inspection and testing ports for in place leakage testing of the HEPA filter which meets ASME N510 standard. Standards WSRC-TM-95-1, SRS Engineering Standard No 15889, Confinement Ventilation Systems Design Criteria. WSRC-TM-95-1, SRS Engineering Standard No 15888, HEPA Filter Requirements. References SRS Manual 2Y1, Procedure 104, General Surveillance Test of HEPA Filters. Gap Analysis No gaps identified.	DOE-HDBK-1169 (2.3.8) ASME AG-1 ASME N510

Evaluation Criteria	Discussion	Reference
Instrumentation required to support system operability is calibrated (Discussion – Credited instrumentation should have specified calibration/surveillance requirements. Non-safety instrumentation should be calibrated as necessary to support system functionality.	Instrumentation required to support system operability and safety functions will be calibrated on a periodic basis in accordance with the SRS standards and the safety analysis. Appropriate programs will be established to procure the necessary equipment, train personnel, and calibrate equipment to ensure system functions and accuracy. The majority of instrument calibration requirements will be established and specified during final design. <u>Standards</u> WSRC-TM-95-1, SRS Engineering Standard No 15889, Confinement Ventilation Systems Design Criteria. <u>Reference</u> SRS Site Manual 1Q, Procedure 12-2, *Control of Installed Process Instrumentation* <u>Gap Analysis</u> No gaps identified.	DOE-HDBK-1169 (2.3.8)
Integrated system performance testing is specified and performed (Discussion – Required responses assumed in the accident analysis must be periodically confirmed including any time constraints)	An integrated system performance testing will be specified and performed. Chapter 10 of the PDSA makes commitments to test initial equipment installations and any subsequent modifications through a formalized process to ensure that the system will operate within its approved safety basis. A program to execute integrated system performance testing will be established. This program will test and evaluate components and systems against documented criteria. The majority of integrated system performance testing will be established and specified during Title III design. <u>Reference</u> WSRC-SA-2003-00002, WSB Preliminary Documented Safety Analysis, Chapter 10 <u>Gap Analysis</u> No gaps identified.	DOE-HDBK-1169 (2.3.8)
	9 – Maintenance	
Filter service life program should be established (Discussion – Filter	WSRC Manual 2Y requires a filter service life program be established. This program will collect engineering data on each of the filter elements, which includes type, size, flow rate, pressure drop, and anticipated life based on the application. Records will be maintained on the replacement history for each filter and service life modified. The majority filter service life program requirements and associated specifics are established in SRS Engineering Standard 15888 and will be confirmed during final design.	DOE-STD-1169 (3.1 & App C)

Evaluation Criteria	Discussion	Reference
life (shelf life, service life, total life) expectancy should be determined. Consider filter environment, maximum delta-P, radiological loading, age, and potential chemical exposure.	Standards SRS Engineering Standard 15888, HEPA Filter Requirements References WSRC Manual 2Y, Procedure 1.00, SRS HEPA/Sand Filter Program Gap Analysis No gaps identified.	
10 – Single Failure		
Failure of one component (equipment or control) shall not affect continuous operation	Electrical and I&C According to DOE O 420.1B, SC electrical systems must be designed to preclude single point failure. DOE G 420.1-1 provides the application of national codes and standards that a SC electrical system must meet to ensure the single-failure criterion is achieved. The design of the SS portion of the electrical distribution system does not meet single-failure criterion such as independence, redundancy and common-cause and cascaded failures identified in IEEE 379. The design criteria and testing requirements identified in IEEE 308, and separation requirements identified in IEEE 384 are also not met. The design of the SS portion of the electrical distribution system does comply with the national codes and standards provided in DOE G 420.1-1 for a SS electrical power system. The logic solvers for SS instrumented systems meet the redundancy and independence requirements identified in IEEE 379. Mechanical The mechanical portion of the ACVS SS subsystems (HAW PVV and HAW Ventilation) is designed for major equipment redundancy. Redundant exhaust HEPA filters and fans have been provided in the design. Some non-active components such as piping and process vessel connections are not redundant. The ACVS SS subsystems are designed to meet SRS Standard 15889 which also invokes ASME AG-1. Standards IEEE std 308, IEEE Standard Criteria for Class 1E Power Systems for Nuclear Power Generating Stations IEEE std 379, IEEE Standard Application of the Single-Failure Criterion to Nuclear Power Generating Station	DOE O 420.1B, Facility Safety, Chapter I, Sec 3.b(8)

Evaluation Criteria	Discussion	Reference
	Safety Systems IEEE std 384, IEEE Standard Criteria for Independence of Class 1E Equipment and Circuits ASME AG-1 Code for Nuclear Air and Gas Treatment <u>References</u> G-FDD-F-00007, Facility Design Description for Waste Solidification Building. M-SYD-F-00055, WSB System Design Description for HVAC System. M-M5-F-2865, WSB Process Area and Lab Modules Air Flow Diagram E-E2-F-3271, WSB Electrical Power Distribution System 13.8kV/480V Single Line Diagram E-E2-F-03313, WSB 480 Standby D/G Power Single Line Diagram <u>Gap Analysis</u> A gap exists between the design of the ACVS SS subsystems (HAW PVV and HAW Ventilation) and SC single-failure criterion. The electrical distribution system SS design does not meet the SC single-failure criterion as defined in DOE O 420.1B and DOE G 420-1.1.	
Automatic backup electrical power shall be provided to all critical instruments and equipment required to operate and monitor the confinement ventilation system	The SS portion of the electrical distribution system supplies electrical power to the two HAW Ventilation fans, the two HAW PVV fans and isolation dampers associated with these fans, logic solvers, alarms and instruments. The SS portion of the electrical distribution system includes two motor control centers (MCC), two automatic transfer switches, and one backup diesel generator. Each MCC supplies electrical power to one fan and associated isolation dampers in each system and normally receives electrical power supply from one of two electrical distribution feeders. Each feeder is powered from one of two 13.8 kV distribution feeders. Incorporated into the design of the two feeders supplying the MCCs are two automatic transfer switches, each being capable of starting the SS diesel generator, and transferring the SS loads to the generator during the loss of normal power. The PDSA does not credit the function of the WSB Building Exhaust, Air System, and Clean Area HVAC. These systems are supplied by normal power and are not backup by the diesel generator. <u>Standards</u> WSRC-TM-95-1, SRS Engineering Standard No 15889, Confinement Ventilation Systems Design Criteria.	DOE-HDBK-1169 (2.2.7)

Evaluation Criteria	Discussion	Reference
	References G-FDD-F-00007, Facility Design Description for Waste Solidification Building. M-SYD-F-00055, WSB System Design Description for HVAC System. M-M5-F-2865, WSB Process Area and Lab Modules Air Flow Diagram E-E2-F-3271, WSB Electrical Power Distribution System 13.8kV/480V Single Line Diagram E-E2-F-3313, WSB 480 Standby D/G Power Single Line Diagram Gap Analysis No gaps identified.	
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 HAW process tanks contain material that is constantly producing hydrogen by radiolytic and chemical decomposition. To assure that the potential for hydrogen explosion does not result from these operations, a constant dilution flow is kept in the tank headspace above the liquid. This flow is provided by the HAW process vessel vent (PVV) subsystem. The PVV subsystem has a functional classification of SS and is designed to meet PC-3+ seismic criteria and PC-3 criteria for other NPH events. Building air is introduced into the process vessels through inlet air HEPA filters. Two PVV filtration skids (includes: condenser, moisture separator, reheater and two stages of HEPA filters), located in separate fire zones, provide filtration of the exhaust coming from the tanks. This arrangement provides for redundant exhaust filtration capability such that one HEPA is operating while the second is in standby in case of a problem with the operating HEPA. Two direct drive fans installed in parallel (one operating and one in standby) provide the motive force for the HAW PVV subsystem. A diesel generator provides back-up power in the event of the loss of normal power. A flow measurement device is provided on the inlet air side of each HAW process vessel. The flow measurements ensure that the HAW PVV subsystem is active and is drawing purge air into the vessels. The vacuum produced by the HAW PVV subsystem causes air to flow from the building into the vessels, which dilutes the concentration of hydrogen inside of the tanks. An auxiliary exhaust connection on the HAW PVV subsystem provides a tie-in location for a portable air handling device that is capable of being used during maintenance or off-normal situation. Gap Analysis No gaps identified.	10 CFR 830, Subpart B

Attachment 4 – WSB Facility Evaluation Team

James T. Salley (Tim)

Project Design Authority Engineer
Nuclear Nonproliferation Programs

Tim Salley is a Project Engineer in the Plutonium Disposition Program Design Authority organization at the Savannah River Site. He provides technical reviews for project activities and currently serves as a Design Authority Engineer for the Waste Solidification Building.

Prior to his assignment to the PDP Design Authority, Mr. Salley was a project design authority in the Nuclear Materials Management Division (NMMD) at SRS. He provided design authority functions for various projects within the division including independent assessments of construction and startup activities.

Before joining NMMD, Mr. Salley was the E&I/Maintenance Manager for the TNX facility at SRS. He managed a maintenance and work planning organization performing plant maintenance and modification activities for advance research and development processes. His duties also included implementing new Conduct of Maintenance programs and procedures for the organization.

Mr. Salley was an engineer in the Reactor Works Engineering Department at SRS. He provided technical assistance in repairing electrical and instrumentation systems for the Reactor Areas. Later assignments included serving as the Preventive Maintenance Manager for the Reactor Restart Division and as the L Reactor Maintenance Planning Manager.

Mr. Salley has served as a System Engineer and was a member of a seismic upgrade team for the reactor safety systems. His responsibilities included providing design inputs and process limits for safety systems.

Mr. Salley has a BS in Electrical Engineering from Tennessee Technological University.

Douglas R. Melton, PE
Savannah River Nuclear Solutions

Doug Melton is a principal engineer with the WSB Design Authority group. He has lead DA responsibility for several process areas within WSB.

Mr. Melton has 20 years experience at Savannah River Site. Before joining the WSB Design Authority group, Mr. Melton worked in Future Mission Program and Trade Studies Group providing engineering support to the Plutonium Immobilization Program.

Prior to his assignments in the new mission programs, Mr. Melton worked in the Engineering Department for Nuclear Material Management Division. He was the lead engineer for the HB-Line System Engineering Group. He provided facility engineering support during the Cassini Program (Pu-238 mission). He was involved in the development and implementation of the safety documentation for HB-Line Pu-238 operations.

Mr. Melton is a licensed professional engineer with the State of South Carolina. He has M.Eng and BS degrees in Chemical Engineering from the University of Louisville.

Mike Munie, PE
Savannah River Nuclear Solutions

Mike Munie is the lead mechanical design engineer for the Waste Solidification Building project. He is in the PD&CS division. He has 16 years of design experience at SRS as a lead mechanical design engineer. His facility assignments include the Defense Waste Processing Facility, Tritium Facilities, F&H Canyon, and F&H Tank Farms. His project assignments include the Modular Caustic Side Solvent Extraction (MCU), HEU Blendown, and Non-Nuclear Reconfiguration (NNR).

Prior to working at SRS he worked for 10 years at a commercial nuclear power plant for Illinois Power Company. He was responsible for oversight of design and construction of various nuclear steam supply and HVAC systems at the plant.

Mr. Munie is licensed professional engineer with the State of South Carolina. He has BS degree in Mechanical Engineering, a Masters of Engineering degree, and a Masters in Business Administration.

Richard R. Haddock, PE
Washington Safety Management Solutions

Richard Haddock is an engineer with WSMS and has 6 years experience in the Hazards analysis and safety basis development for various DOE facilities. Richard currently works in the WSMS Regulatory Programs group supporting the WSB design team and the PDCF Design Authority.

Prior assignments for WSMS include development and support of the DSA for the K-Area Material Storage Facility, Regulatory support for the SRS Solid Waste Management Facility, Preliminary Safety Basis development for the MPF, support engineer for Waste Determination Document development for the closure tanks 18F and 19F, and various other support tasks for SRS facilities.

Mr. Haddock is a registered professional engineer in the state of South Carolina. He has a BS degree in Civil Engineering and a MS degree in Environmental Engineering from Clemson University.

Joel A. Clark
Savannah River Nuclear Solutions

Joel Clark is a principal engineer with WSRC and has 17 years experience in nuclear facilities. Joel works in the WSB Operations and Maintenance (O&M) group. Joel was in the Pit Disassembly and Conversion Facility (PDCF) Operations and Maintenance (O&M) group for over 4 years where he is responsible for many areas of the design, including fire protection.

Prior assignments at WSRC include 6 years as the Fire Protection Coordinator for the 221-F Canyon. Mr. Clark was responsible for reviewing and approving Fire Hazards Analyses, Fire Protection Program plans, Impairment procedures, etc. Mr. Clark also supervised many facility fire protection system upgrades.

Mr. Clark is a registered professional engineer (Inactive) in the state of South Carolina. Joel has a BS degree in Mechanical Engineering from Clarkson University.

Larry M East, PMP
Savannah River Nuclear Solutions

Larry East is a staff member of the Nuclear Nonproliferation Program, WSRC. He provides reviews and consultation on Project Management, Engineering Management, Nuclear Safety Analyses, Regulatory Requirements, Operations, Maintenance, Reliability, Confinement Ventilation Systems, Nuclear Facilities Safeguards and Security, and Modification of Nuclear Facilities. His assignments with WSRC have included Project Manager (DOE Major Project), Design Authority (HEU Blendown), Engineering Manager, and Facility Evaluation Board.

Prior to his tenure at WSRC, Mr. East was employed as Manager of Project Management at a commercial nuclear power plant for Carolina Power & Light Co (7 yrs), Supervisory Project Manager for Department of Energy (10yrs), Nuclear Facility Regulator and SC Rad Health Officer for SC Dept of Health & Environmental Control (3 yrs), and US Navy Nuclear Submarine program, Operations and Training (7yrs). Mr. East had a parallel career in the US Navy Reserve, Retiring as a Commander, Civil Engineer Corps. He commanded Navy Construction Forces (Seabees) and performed government Contracting Officer responsibilities in the US and abroad.

Mr. East is a member of Project Management Institute International and American Society of Military Engineers. He is a certified Project Management Professional, PMI. Larry has a BS in Mechanical Engineering and a Masters in Business Administration.