Department of Energy
Washington, DC 20585

DEC 29 2009

MEMORANDUM FOR JEFFREY M. ALLISON
MANAGER
SAVANNAH RIVER OPERATIONS OFFICE

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

SUBJECT: Evaluation of Savannah River Site Facility Ventilation Systems in Response to Defense Nuclear Facilities Safety Board Recommendations 2004-2, Final Reports

Based on review of the information included in the subject reports, evaluation by the Defense Nuclear Facilities Safety Board (DNFSB) 2004-2 Independent Review Panel, the Environmental Management Technical Advisory Board, and input from the Chief of Nuclear Safety Office, the reports are approved with the following considerations:

- For the Tank Farm Waste Tank and Transfer Facility, an equivalent process to that required by DNFSB Recommendation 2004-2 was conducted during the Documented Safety Analysis (DSA) upgrade process for the Tank Farm Waste Tank and Transfer Facility. Vulnerabilities identified equivalent to gaps are identified and prioritized in the DSA. These vulnerabilities are required to be updated annually and tracked for execution as funding becomes available.

- For the Defense Waste Processing Facility, the ventilation systems were appropriately evaluated against the safety significant criteria associated with the established DNFSB 2004-2 evaluation guidelines, with a gap associated with the lack of a continuous on-line monitoring system. The Facility Evaluation Team (FET) analyzed the cost benefit analysis of physical modifications to close the gap, and concluded gap closure was not warranted. Periodic sampling of the Zone 2 system is made via grab samples versus continuous online monitoring.

- For the Savannah River Site (SRS) Evaporator Facilities, the ventilation systems were appropriately evaluated against the safety significant criteria associated with the established DNFSB 2004-2 evaluation guidelines, with gaps identified with respect to the safety-significant criteria. These being: (1) Three gaps associated with no installed post-accident monitoring capability for the three evaporators, (2) Lack of 242-25H Primary Ventilation System reliability during normal operations. The FET recommends that no action be taken to add post accident monitoring capability to the evaporators' ventilation systems due to the

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limited, if any, overall dose reduction and cost. However, the FET does recommend that the previous action to review the 242-25H design for possible improvements should be given a higher priority, and that modifications be made to improve its reliability during normal operations.

- For the Defense Waste Processing Facility Low Point Process Pit, the ventilation systems were appropriately evaluated against the safety significant criteria associated with the established DNFSB 2004-2 evaluation guidelines, with three gaps identified with respect to the safety-significant criteria. These being: (1) effluent from the stack is not continuously monitored, (2) backup power is not supplied to the exhaust fan, and (3) no direct differential pressure (DP) measurement between environment and the Maintenance and Service area. The FET recommended that due to the low risk associated with the gaps, no gaps needed to be closed. DP measurement is not required since exhaust flow indication exists, and supply is infiltration from outside.

- For the H-Canyon and HB-Line Facilities, the ventilation systems were appropriately evaluated against the safety class criteria associated with the established DNFSB 2004-2 evaluation guidelines, with three performance gaps identified with respect to the safety class criteria. These being: (1) failure of the stack liner in a seismic event, (2) failure of the stack and stack liner in a tornado/wind event, and (3) temporary release of unfiltered air from HB-Line during a fire event. The FET recommends that upgrades to these systems be evaluated during the H-Canyon and HB-Line Safety Basis upgrade. The safety basis document is under final review by DOE-SR. The TAB requests a briefing on the results of the Safety Basis Upgrade upon approval, and a presentation on the DOE-SR conclusions on ventilation system upgrades in light of current and future missions of H-Canyon and HB-Line.

- For the Savannah River National Laboratory (SRNL) Building, the ventilation systems were appropriately evaluated against the safety class criteria associated with the established DNFSB 2004-2 evaluation guidelines, with fifty-eight gaps identified with respect to the 15 active ventilation systems. No gaps were found to involve a discrepancy between the DSA and design. The FET recommended closure (contingent upon funding) of 24 of the 58 gaps over a period of 4 to 6 years at an estimated cost of $23M to $33M, to improve reliability and effectiveness of an integrated active confinement ventilation for facility worker protection. The TAB recommends that DOE-SR review the potential for unfiltered and unmonitored releases from "tertiary" clean areas of the SRNL Building and determine if closure of identified gaps for the tertiary area ventilation is warranted.

- For the SRS F&H Area Analytical Laboratories, the ventilation systems were appropriately evaluated against the safety significant criteria associated with the

established DNFSB 2004-2 evaluation guidelines, with eight performance gaps identified with respect to the safety-significant criteria. These being: (1) building layout does not provide confinement zone separation, (2) some primary filter housings do not provide a robust seal, (3) the relay cabinet is not environmentally qualified, (4) the supply and exhaust interlock is not SS qualified, (5) control system interlocks are not SS qualified, (6) control system components are not fail safe, (7) the design does not permit in-place leak testing, and (8) backup power cables being subject to identified accidents. No gaps were found to involve a discrepancy between the DSA and design. FET recommends closure of gaps 1, 4, 6, and 8 to improve system reliability. The TAB recommends that SR review the potential for unfiltered and unmonitored releases from "tertiary" clean areas of the F&H Area Laboratories and determine if closure of identified gaps for the tertiary area ventilation is warranted.

- For the SRS Outside Facilities-H, no evaluation was made against established guidelines since these facilities are outside, without confinement and existing active ventilation systems.

- For the SRS L-Area Material Storage Facility (MSF), there is no current confinement ventilation system for the Disassembly Basin section of the facility. Historically, the ventilation system was used for personnel comfort and functionally classified as General Service, but is currently inoperable. The L Area MSF Documented Safety Analysis credits other safety class and safety significant controls for preventing and mitigating accidents. The FET evaluated the cost and safety benefit of modifying the facility to have an active confinement ventilation system and concluded that the cost of modifying the facility was not warranted because there is very little safety benefit to be gained, given that accidents are prevented or mitigated by other safety controls.

- For the SRS Solid Waste Management Facilities, the ventilation systems were appropriately evaluated against the defense in depth criteria associated with the established DNFSB 2004-2 evaluation guidelines as Hazard Category 3 facilities, without active ventilation systems. These facilities have no ventilation systems. Options were evaluated for equipping the buildings with ventilation systems, or building new facilities along with current operation. The FET recommended the continued use of the facilities as they exist due to the low risk of these existing facilities.

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

Attachments

cc:
D. Chung, EM-2
F. Marcinowski, EM-3
M. Gilbertson, EM-50

INDEPENDENT REVIEW

OF

Savannah River Site Defense Waste Processing Facility (DWPF) Low Point Pump Pit (LPPP) Process Vessel Ventilation System Evaluation Report

June 2009

Executive Summary

The DNFSB Recommendation 2004-2 Independent Review Panel (IRP) reviewed the Savannah River Site (SRS) Defense Waste Processing Facility (DWPF) Low Point Pump Pit (LPPP) Process Vessel Ventilation (PVV) System Evaluation Report utilizing the process and criteria outlined in DOE's *Ventilation System Evaluation Guidance for Safety-Related and Non-Safety-Related System* (2004-2 Ventilation System Evaluation Guide).

The LPPP is a Hazard Category 2 nuclear facility. The evaluation report covered the LPPP PVV System and the LPPP Building Maintenance and Service Area active ventilation systems. The LPPP Process Vessel System and the Building Maintenance and Service Area Ventilation System are both functionally classified as Production Support due to the low consequences to both onsite and off-site receptors from postulated events and the use of other safety related components to prevent or mitigate an event. They are not credited nor required to perform an active confinement function during design basis accidents. SRS reviewed the system function classification as part of the ventilation evaluation in accordance with the 2004-2 Ventilation System Evaluation Guide to ensure it was appropriately classified.

Although the ventilation systems were classified below the Safety Significant levels, SRS evaluated the ventilation systems for the LPP Building against the Safety Significant performance criteria (because the 2004-2 Ventilation System Evaluation Guide specified that ventilation systems for Hazard Category 2 facilities will be evaluated, as a minimum, against the Safety Significant criteria). SRS identified three performance gaps, i.e., no continuous online monitoring system for the LPPP effluent, no indication of differential pressure between the atmosphere and the Maintenance and Service Area, and no supply emergency power to the Maintenance and Service Area fan. In accordance with the 2004-2 Ventilation System Evaluation Guide, SRS performed a cost benefit analysis to determine whether modifications were warranted to close the performance gaps and concluded that modifications were not cost beneficial.

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

Results of Independent Review Panel's Review of the Savannah River Site Defense Waste Processing Facility (DWPF) Low Point Pump Pit (LPPP) Process Vessel Ventilation System Evaluation Report

1. INTRODUCTION

The DNFSB Recommendation 2004-2 Independent Review Panel (IRP) reviewed the Savannah River Site (SRS) Defense Waste Processing Facility (DWPF) Low Point Pump Pit (LPPP) Process Vessel Ventilation System Evaluation Report utilizing the process and criteria outlined in DOE's *Ventilation System Evaluation Guidance for Safety-Related and Non-Safety-Related System* (2004-2 Ventilation System Evaluation Guide).

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

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

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

2. FACILITY AND VENTILATION SYSTEM OVERVIEW

This evaluation included the LPPP PVV System and the LPPP Building Maintenance and Service Area active ventilation systems. Underground inter-area pipelines are used to transfer High Level Waste slurries between H-Area and DWPF. Similarly, a separate underground line is used to transfer aqueous radioactive waste generated in DWPF to the H-Area Tank Farm via the LPPP Recycle Waste Tank (RWT). The design of the LPPP Building incorporates multiple confinement levels to minimize releases of radioactivity to the environment and to minimize transport of radioactive contaminants within the facility. The primary confinement for the radioactive material at LPPP consists of the process vessels and piping, process cells and cell covers, and process vessel vent system.

The PVV system is provided at the LPPP to limit the release of radioactive materials, to control the atmosphere within the process tanks, and to limit radioactive particulate escape in the event of over-pressurization. Ventilation of the LPPP Building Maintenance and Service Area is provided to filter radioactive contamination (if present) from the air before discharge to the environment, to provide assistance with cell

ventilation when cell covers are removed, and to maintain the Maintenance and Service Area at a slight negative pressure with respect to atmospheric pressure.

The LPPP Process Vessel System and the Building Maintenance and Service Area Ventilation System are both functionally classified as Production Support due to the low consequences to both onsite and off-site receptors from postulated events and the use of other safety related components to prevent or mitigate an event.

3.0 REVIEW RESULTS

3.1 Derivation of Ventilation System Performance Criteria and Confinement Strategy

The DWPF LPPP PVV System Evaluation Report appropriately followed the process outlined in the 2004-2 Ventilation System Evaluation Guide in developing the Data Collection Table used to identify accidents, their unmitigated consequences, and the confinement strategy. The hazard analysis for the LPPP facility did not identify accidents that could lead to consequences challenging the offsite Evaluation Guidelines (EGs); however, accidents that could challenge the onsite EG were identified. These accidents include explosions in the process vessels, spill and leaks, seismic and tornado/high winds. The bounding event, seismic impact on the LPPP Building, yielded an unmitigated dose of 0.86 rem for the offsite receptor and 400.6 rem for the collocated workers. The seismic related explosion events are prevented with Performance Category (PC)-2 seismically qualified Safety Significant nitrogen purge. The LPPP superstructure, crane, vaults, cell covers, jumpers, above the purge jumpers, sludge pump tank and precipitate pump tank are also PC-2 seismically qualified.

The recycle waste tank and strip effluent jumper in the sludge pump tank cell are not credited to survive a PC-2 seismic event and are therefore assumed to fall, resulting in a spill of their contents. This results in a mitigated onsite dose of 10.05 rem, with the majority of the dose due to the spill of the recycle waste tank contents (10 rem). Neither the PVV nor the Building Maintenance or Service Area Ventilation systems are credited for any Design Basis Accidents. A spill of 15,000 gallons of sludge during an Inter-Area transfer results in an onsite dose of 17.8 rem. The LPPP cell vaults and cell covers are credited with providing mitigation for these events.

Based upon this evaluation, SRS determined that the LPPP Process Vessel System and the Building Maintenance and Service Area Ventilation System are both appropriately functionally classified as Production Support.

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

3.2 Evaluation of Ventilation System Against the Selected Performance Criteria

Although the ventilation systems were classified below the Safety Significant level, SRS evaluated the ventilation systems for the LPP Building against the Safety Significant performance criteria (because the 2004-2 Ventilation System Evaluation Guide specified

that ventilation systems for Hazard Category 2 facilities will be evaluated, as a minimum, against the Safety Significant criteria).

The SRS DWPF LPPP PVV System Evaluation Report included a brief description of how the ventilation systems met the criteria and specified reference documents used as part of the review.

The SRS DWPF LPPP PVV System Evaluation Report identified three gaps with respect to the DNFSB 2004-2 Evaluation Guidance. The first gap was found with both systems in that effluent from the LPPP Stack is not continuously monitored as DNFSB Tech 34 suggests. The second gap identified in the LPPP Building Maintenance and Service Area Ventilation is that emergency power is not provided to the exhaust fan. The final gap with the LPPP Building Maintenance and Service Area Ventilation is that there is no direct DP measurement between the environment and the Maintenance and Service Area.

The IRP concluded that evaluation of the ventilation systems against the 2004-2 Ventilation System Evaluation performance criteria was appropriately performed.

3.3 Evaluation of physical modifications to enhance safety performance

WSRC-IM-2002-000014, SRS Air Emissions Monitoring Graded Approach, identified the LPPP as a potential impact category IV source (potential effective dose equivalence of $\leq$ 0.00002 mrem/year). Monitoring requirements were changed from continuous to an annual grab sample. Due to the cost associated with maintaining the system, the need to replace obsolete equipment, and the change in regulatory drivers, the continuous air monitoring system was removed by J-DCP-S-03017. It is estimated that the project cost to reinstall a continuous online monitoring system would be $3,460,000 ($2,422,000 to $5,190,000) with an additional cost of $1,200,000 ($840,000 to $1,800,000) for upgrading the system to being PC-2 NPH qualified. This is a Class 5 estimate prepared by SRS Site Estimating. This does not include the cost associated with qualifying the PVV System to function during and after a PC-2 NPH event. The FSAR does not credit PVV System for providing any mitigation for design basis accidents as the cell vaults and shield covers provide adequate mitigation. Both the LPPP PVV and Building and Service Area discharge through a common stack.

The LPPP Building Maintenance and Service Area Ventilation System does not have a direct measurement of differential pressure between the atmosphere and the Maintenance and Service Area. The Service and Maintenance Area is separated form the outside by sheet metal that is attached to the LPPP superstructure. Air is pulled into this area via six wall mounted counterweighted louvers. The louvers start to open at 0.05 inches water column and each is rated for 2,020 standard cubic feet per minute. There is a low flow alarm for the system. The system is not cascaded and thus flow provides an adequate measure of system performance. The fan is controlled via flow. It is estimated that the cost to install a differential pressure monitor is $60,000 ($60,000 to $90,000). This estimate was provided by SRS design engineering.

The LPPP Building Maintenance and Service Area Ventilation System does not have emergency power supplied to its fan. It is estimated that project cost to connect the fan to

INDEPENDENT REVIEW

OF

Savannah River Site
Evaporator Facilities
Ventilation System Evaluation Report

October 2009

Executive Summary

The Defense Nuclear Facilities Safety Board (DNFSB) Recommendation 2004-2 Independent Review Panel (IRP) reviewed the Savannah River Site (SRS) 242-16F, 242-16H and 242-25H Evaporator Facilities Ventilation System Evaluation Report utilizing the process and criteria outlined in Department of Energy's *Ventilation System Evaluation Guidance for Safety-Related and Non-Safety-Related System* (2004-2 Ventilation System Evaluation Guide).

The three SRS evaporator facilities are Hazard Category 2 facilities. Active confinement ventilation systems in these facilities are not safety related due to moderate radiological dose consequences to both on-site and off-site receptors from postulated events. The evaporator ventilation systems are functionally classified as Production Support (PS) and were qualitatively assessed to meet Performance Category 1 (PC-1) criteria for the applicable Natural Phenomena Hazard (NPH) events. SRS reviewed the system functional classification as part of the ventilation evaluation in accordance with the 2004-2 Ventilation System Evaluation Guide and determined it was appropriate.

Although the ventilation systems were classified below the Safety Significant level, SRS evaluated the ventilation systems for the three evaporator facilities against the Safety Significant performance criteria in the 2004-2 Ventilation System Evaluation Guide (because the 2004-2 Ventilation System Evaluation Guide specified that ventilation systems for Hazard Category 2 facilities will be evaluated, as a minimum, against the Safety Significant criteria). SRS identified performance gaps between the Safety Significant criteria and the evaporator ventilation system designs. These gaps were deemed to be discretionary in nature since none of the gaps involved a discrepancy between the Safety Basis requirements and the system designs. In accordance with the 2004-2 Ventilation System Evaluation Guide, SRS performed a cost benefit analysis to determine whether modifications were warranted to close the performance gaps and concluded that modifications were not cost beneficial.

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

Results of Independent Review Panel's Review of the Savannah River Site Evaporator Facilities Ventilation System Evaluation Report

1. INTRODUCTION

The DNFSB Recommendation 2004-2 Independent Review Panel (IRP) reviewed the Savannah River Site (SRS) Evaporator Facilities Ventilation System Evaluation report utilizing the process and criteria outlined in DOE's *Ventilation System Evaluation Guidance for Safety-Related and Non-Safety-Related System* (2004-2 Ventilation System Evaluation Guide).

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

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

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

2. FACILITY AND VENTILATION SYSTEM OVERVIEW

Radioactive waste is received in the tank farms in liquid form. The volume of this waste is reduced by evaporation to about one-third of its original liquid volume or immobilized as a salt cake thereby increasing usable tank space. To achieve this reduction in liquid volume and its associated gain in tank space, evaporators are provided in each tank farm for the concentration of radioactive waste. There are three operating evaporators that have active ventilation systems. Each of the three evaporators has an associated evaporator cell ventilation system; the 242-25H evaporator has a secondary ventilation system which ventilates the service building; and 242-16H has a mercury removal system ventilation system.

The evaporator cell ventilation systems are similar in their design and operation, however, the 242-25H evaporator is newer than the other evaporators and subsequently its cell ventilation system has been designed to more current codes and standards. The evaporator cell ventilation system maintains a negative pressure on the condenser and evaporator cells to provide cooling, remove flammable gases, and prevent the spread of contamination through joints in the cell covers to the outside environment. The 242-25H

Secondary Ventilation System (SVS) ventilates the 242-25H Service Building. The SVS is a once-through induced draft air system, drawing in outside air, distributing the air throughout the ventilated areas, collecting exhaust air through a ductwork system, directing exhaust air through HEPA filter banks, and then discharging the filtered exhaust air to the atmosphere through an elevated discharge stack equipped with a CAM. The 242-16H Mercury Removal System Ventilation System is a once-through induced draft air system that removes mercury vapor and potentially contaminated air from the mercury and overhead tank sample hoods and each overhead tank vent. The exhaust duct is connected to a HEPA filter unit located before the exhaust fan. The filtered air and vapor is expelled by the exhaust fan through an exhaust stack to the atmosphere. The 242-16H Mercury Removal System Ventilation System was installed to provide for an elevated release point for mercury vapors that could be present within the evaporator overhead tanks or the mercury collection/sample station.

Although the SRS Evaporator Facilities are properly designated as Hazard Category 2, the 242-16H Mercury Removal System Ventilation System portion was treated as a Hazard Category 3 facility segment for the purposes of performing DNFSB 2004-2 evaluations due to the low consequence potential.

3.0 REVIEW RESULTS

3.1 Derivation of Ventilation System Performance Criteria and Confinement Strategy

The active confinement ventilation systems in the F and H Tank Farm Evaporator Facilities are functionally classified as PS and PC-1. The 242-16F, 242-16H and 242-25H Evaporator Cells are functionally classified as Safety Class (SC) for PC-3 Tornado/High Wind events and Safety Significant (SS) for a Wildland Fire event. There are no SS or SC functions for the existing active confinement ventilation systems associated with the F and H Tank Farm Evaporators. The evaporator ventilation systems are not credited by the DSA to operate during or following any DBA events, including NPH events.

The DSA dose calculations did not identify any evaporator events that challenge the 25 rem Evaluation Guideline from DOE-STD-3009 for the public or the 100 rem Co-located Worker criteria per Washington Savannah River Company Procedure E7 2.25, Functional Classification as applied at 100-meters. The bounding event, an Evaporator Overpressure (242-16F Evaporator during a seismic event) yielded an unmitigated onsite dose consequence potential of 50.2 rem and less than 0.1 rem to the offsite public. As such the active confinement ventilation systems in the F and H Tank Farm Evaporators as appropriately classified as PS.

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

3.2 Evaluation of Ventilation System Against the Selected Performance Criteria

Although the ventilation systems were classified below the Safety Significant level, SRS evaluated the ventilation systems for the SRS Evaporator Facilities against the Safety Significant performance criteria (because the 2004-2 Ventilation System Evaluation Guide specified that ventilation systems for Hazard Category 2 facilities will be evaluated as a minimum, against the Safety Significant criteria).

The SRS Evaporator Facilities Evaluation Report included a brief description of how the ventilation systems met the criteria and specified reference documents used as part of the review.

The SRS Evaporator Facilities Evaluation Report identified four gaps with respect to the DNFSB 2004-2 Evaluation Guidance. The first three gaps are associated with the 242-16F, 242-16H and 242-25H Evaporator Cell Ventilation Systems and the 242-25H Evaporator Secondary Ventilation System having no installed post-accident monitoring capability. Installed filter break-through monitoring capability is provided on the Evaporator Cell and Building ventilation systems addressed by this report. However, this instrumentation is provided for routine release monitoring only in compliance with applicable environmental permit requirements/commitments and serves no safety function.

The last gap is associated with improving the 242-25H Primary Ventilation System (PVS) reliability during normal operations. The PVS control system design is not robust, and minor system transients (e.g., removing cell cover seam weather stripping) can interlock the system off. Engineering had previously initiated actions to evaluate the system design for potential modifications that would improve overall system reliability/efficiency. However, this evaluation has not been completed due to other priorities.

The IRP concluded that evaluation of the ventilation systems against the 2004-2 Ventilation System Evaluation performance criteria was appropriately performed.

3.3 Evaluation of physical modifications to enhance safety performance

The cost estimate for installing a PC-2 qualified Post Accident Monitoring System for the 242-25H Evaporator Cell Ventilation System and the 242-25H Evaporator Secondary Ventilation System ranged from a low of $5,982,200 to a high of $12,819,000. The cost estimate for installing a PC-2 qualified Post Accident Monitoring System for the 242-16F and 242-16H Evaporator Cell Ventilation Systems ranged from a low of $3,038,000 to a high of $6,510,000 for <u>each</u> system. The imposition of this post-accident monitoring criterion on the Evaporator ventilation systems under the scope of this report is not practical given the very high likelihood for multiple radiological release paths to exist following a DBA in an Evaporator Facility. Because of the high potential for multiple post-accident release paths, the prudent post-accident monitoring approach is to rely on the use of portable survey equipment as a key element of the SRS Emergency Response Program.

INDEPENDENT REVIEW

OF

Savannah River Site (SRS)
F & H Area Analytical Laboratory
Ventilation System Evaluation Report

July 2009

Executive Summary

The Defense Nuclear Facility Safety Board (DNFSB) Recommendation 2004-2 Independent Review Panel (IRP) reviewed the Savannah River Site (SRS) F & H Area Analytical Laboratory Ventilation System Evaluation report utilizing the process and criteria outlined in Department of Energy's (DOE's) *Ventilation System Evaluation Guidance for Safety-Related and Non-Safety-Related System* (2004-2 Ventilation System Evaluation Guide).

The SRS F& H Area Analytical Laboratory is a Hazard Category 2 nuclear facility. The primary function of the building and associated system is to support the handling of nuclear materials and chemicals in limited bench-scale quantities for analysis. These operations are performed inside the gloveboxes, radiohoods, radiobenches and shielded cells (containment units) contained within the lab modules. Eight gaps were identified between the safety significant criteria and the 772-F and 772-4F designs.

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

Results of Independent Review Panel's Review of the Savannah River Site (SRS) F & H Area Analytical Laboratory Ventilation System Evaluation Report

1. INTRODUCTION

The Defense Nuclear Facility Safety Board (DNFSB) Recommendation 2004-2 Independent Review Panel (IRP) reviewed the Savannah River Site (SRS) F & H Area Analytical Laboratory Ventilation System Evaluation report utilizing the process and criteria outlined in Department of Energy's (DOE's) *Ventilation System Evaluation Guidance for Safety-Related and Non-Safety-Related System* (2004-2 Ventilation System Evaluation Guide).

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

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

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

2. FACILITY AND VENTILATION SYSTEM OVERVIEW

The primary mission of the F/H Labs over the last 50+ years has been to support the chemical separations processing activities at Buildings 221-F and 221-H. Samples received from the canyo0ns and other site areas are subjected to the required radiological and chemical quality control/analyses. Results from these analyses are used to effectively and safely operate the canyon facilities. The mission of the F/H Lab has changed very little over the last 40 years of operation. The projected future use of the facility is to continue its mission to support the separations processes and to provide support for the increasing waste management, waste characterization, waste stabilization, and environmental remediation activities at SRS. F/H Labs will also support the tank farm operations, reactor area programs, the Liquid Waste Disposition Unit, to a limited extent the Defense Waste Processing Facility, and site waste characterization efforts.

The function of the Off Gas Exhaust (OGE) system is to exhaust and filter air from the Gloveboxes. Air from within the laboratory area is drawn through the glovebox

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

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

3.0 REVIEW RESULTS

3.1 Derivation of Ventilation System Performance Criteria and Confinement Strategy

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

There are no active SS or SC functions for the existing active confinement ventilation systems associated with the 772-F Confinement boundary, however the system provides a SS passive boundary. The 772-F and 772-4F active confinement ventilation systems are not credited by the FHLAB DSA to operate during or following any DBA or NPH events. The SRS FET concluded that the SS functional classification of the existing 772-F Building passive confinement ventilation system and GS functional classification of the 772-F Main Exhaust active confinement ventilation System components is appropriate.

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

3.2 Evaluation of Ventilation System Against the Selected Performance Criteria

The 772-F confinement ventilation systems, structures, and components were evaluated against SS, PC-2 & PC-3 criteria. In evaluating the 772-F active confinement ventilation against the SS criteria, the events from the DSA as shown in Table 4.3 and system classification boundaries for each confinement ventilation system played an important

role in determine whether any of the identified gaps and related closure recommendations would be considered discretionary in nature. While the unmitigated consequences for the detonation event were the only accident consequences that drove the 772-F evaluation to SS criteria, a few other credible events for the DSA were considered in the development of Table 5.1.

The SRS FET evaluation identified eight discretionary gaps.

1. The building layout does not provide confinement zone separation. Pressure instrumentation to monitor pressure differential between building interior and outside environment is not available. The 772-F CVS is designed to maintain the required pressure differential during normal operations. It is not credited in the DSA to operate during or following any DBS event, including NPH events.
2. The majority of the Main Exhaust filter housings in the 772-F are 1950's vintage and are constructed with a tape-in-place seal at the inlet and discharge of the HEPA filter frame. These filters do not have a positive seating mechanism that provides a robust seal that is independent of human performance during filter installation.
3. Relay cabinet, CRP-1, located in 772-4F is sensitive to vibration, radiofrequency interference, and/or pressure pulses and is not Safety Significant (SS) or credited as functioning in the DSA. The result of a CRP-1 failure would range from the ventilation system going into a process upset condition (safe mode failure) to a complete shutdown of the ventilation system resulting form the loss of system controls.
4. The exhaust fan interlocks are not SS and are not credited as functioning during or after DBA events.
5. The control system interlocks are not SS and are not required or credited to function during or after DBA events.
6. The controls are not SS and are not required or credited to function during or after DBA events.
7. The installed design for most of the inlet and discharge HEPA filters of the gloveboxes in 772-F does not permit In-Place Leak Testing.
8. Electrical cables are run in open cable trays from 772-4F over the middle of the 772-F roof to the 254-9F diesel generator located on the west side of 772-F. A detonation event could potentially damage these cables and standby power capability (GS) to the 772-4F ventilation system could be lost.

The IRP concluded that evaluation of the ventilation systems against the 2004-2 Ventilation System Evaluation performance criteria was appropriately performed.

3.3 Evaluation of physical modifications to enhance safety performance

2004-2 Ventilation System Evaluation Guide specifies that an evaluation of physical modifications that may be appropriate to enhance the ventilation system in the areas where the current confinement ventilation system does not meet the 2004-2 evaluation criteria should be performed. The SRS FET proposed closure actions, identified costs and recommendation for the eight identified gaps were:

1. Enclose laboratory corridors with doors, install a secondary set of doors at exterior exit on west side of 772-F main floor, and provide zone differential monitoring capabilities. The total ROM cost estimated for closure is $832,000 to $1,664,000. The modification associated with the closure moves the facility closer to meeting current code and standard definition of Zone boundaries and aids in adding a minor ability to minimize the spread of contamination between internal zones but does not mitigate the consequences of the detonation event. There is no discernible benefit or significant risk reduction associated with this gap resolution for any of the bounding accidents in the DSA. The SRS FET does not recommend implementing this gap closure for the mitigation of an event, but does recommend implementation of this gap closure for the perceived benefit in increased system reliability.
2. The closure of this gap would require the replacement of the existing ductwork, clean and dirty plenums, and 26 filter housings with a more current design that contains an engineered installation air, boundary around filter shell, and In-Place Leak Testing of filters. The total ROM cost estimated for this gap closure is $6,200,000 to $12,400,000. The ventilation upgrade primarily brings the immediate laboratory module filtration units up to more current codes and standards but does not improve facility worker protection. The SRS FET does not recommend implementation of this modification for the mitigation of the Detonation event consequences.

3-6. Replace existing CRP-1 Relay Cabinet with a PLC bus system as well as perform upgrade of existing system controls. The total ROM cost estimated for this gap closure is $2,500,000 to $5,000,000. While the implementation of this gap closure, with respect to Gaps 4 and 6, does ensure more rigor is put into maintaining the reliability of the interlocks between the Supply and Exhaust, it does not provide a means of mitigation for the consequences of the Detonation event. There is no discernible benefit or significant risk reduction associated with this gap resolution for any of the bounding accidents in the DSA. The FET does not recommend implementing this gap closure for the mitigation of an event but does recommend implementation of this gap closure for the perceived benefit in increased system reliability.

7. Due to the small diameter welded pipe duct design and limited space available with the existing glovebox installations (except Lab 175) in 772-F Laboratory modules, it is not possible to modify the existing gloveboxes. Therefore in order to close this gap, all glovebox units that are needed for active Analytical Sample analysis will need to be replaced with new glovebox containment units along with lab utilities renovation work as well. The RIM cost estimated for this gap closure is $200,000 to $1,000,000 per glovebox. The total modification ROM ($9,000,000 to $45,000,000) for this gap closure is dependent on the number of gloveboxes needed to support the mission of the lab, the lab currently has and maintains 47 glo9veboxes. The SRS FET does not recommend implementation of this modification for the mitigation of the Detonation event consequences.
8. Replace and relocate cables and cable trays for both Normal Electrical Power and Standby Electrical Power with new cables in environmentally shielded, seismically qualified cable trays. The total ROM cost estimated for this gap closure is $400,000 to $800,000. The FET does not recommend implementing this gap closure for the mitigation of an event but does recommend

implementation of this gap closure for the perceived benefit in increased system reliability.

The IRP concluded that SRS evaluation of the physical modifications was appropriately performed in accordance with the 2004-2 Ventilation System Evaluation Guide.

4. CONCLUSIONS

IRP concludes that the SRS F & H Area Laboratory Ventilation Systems Evaluation Report was performed in accordance with the criteria in the DNFSB 2004-2 Ventilation System Evaluation Guide.

5. RECOMMENDATIONS

The IRP recommends that the Program Secretarial Office and Central Technical Authority accept the SRS F & H Area Laboratory Ventilation System Evaluation Report.

6. REVIEW TEAM MEMBERS

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

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

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

For the SRS F & H Area Laboratory ventilation system evaluation, a detailed-full IRP team review was not determined to be necessary.

INDEPENDENT REVIEW

OF

Savannah River Site
H-Canyon and HB-Line Facilities
Ventilation System Evaluation Report

October 2009

Executive Summary

The DNFSB Recommendation 2004-2 Independent Review Panel (IRP) reviewed the Savannah River Site (SRS) H-Canyon and HB-Line Facilities Ventilation System Evaluation Report utilizing the process and criteria outlined in DOE's *Ventilation System Evaluation Guidance for Safety-Related and Non-Safety-Related System* (2004-2 Ventilation System Evaluation Guide).

The H-Canyon and HB-Line Facilities are Hazard Category 2 nuclear facilities. The evaluation report covered the "H-Canyon Ventilation System," which provides confinement for both H-Canyon and HB-Line Facilities. The portions of the ventilation systems are functionally classified as Safety Class. This functional classification is based upon the high radiological dose consequences to both on-site and off-site receptors from postulated events as evaluated in the Safety Analysis Report (SAR) for each facility. SRS reviewed the functional classification of the ventilation systems as part of the ventilation evaluation in accordance with the 2004-2 Ventilation System Evaluation Guide and concluded that they were appropriately classified.

The Facility Evaluation Team (FET) performing the ventilation system review also evaluated the ventilation systems for the H-Canyon and HB-Line Ventilation System against the Safety Class performance criteria specified in the 2004-2 Ventilation System Evaluation Guide. SRS identified three performance gaps, i.e., failure of the stack liner in a seismic event, failure of the stack and stack liner in a tornado/wind event, and temporary release of unfiltered air from HB-Line during a fire event. The FET recommends that upgrades to these systems be evaluated during the H-Canyon and HB-Line Safety Basis upgrade to a 10 CFR 830 compliant Documented Safety Analysis (DSA) which is currently underway. Any gap resolution will be considered during the DSA review/approval process. Conceptual studies have placed the total system upgrades to be between $7,000,000 and $16,000,000.

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

Results of Independent Review Panel's Review of the Savannah River Site H-Canyon and HB-Line Facilities Ventilation System Evaluation Report

1. INTRODUCTION

The DNFSB Recommendation 2004-2 Independent Review Panel (IRP) reviewed the Savannah River Site (SRS) H-Canyon and HB-Line Facilities Ventilation System Evaluation Report utilizing the process and criteria outlined in Department of Energy's (DOE's) *Ventilation System Evaluation Guidance for Safety-Related and Non-Safety-Related System* (2004-2 Ventilation System Evaluation Guide).

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

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

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

2. FACILITY AND VENTILATION SYSTEM OVERVIEW

This evaluation included the H-Canyon and HB-Line Facilities systems. The H-Canyon and related support facilities were constructed in the 1950s. The original mission of these facilities was to process irradiated/unirradiated uranium target assemblies to recover plutonium for national defense purposes. The facilities were later modified to process enriched uranium fuels and neptunium targets. H-Canyon and its support facilities are classified as Hazard Category 2 based upon uranium and plutonium radiological inventories. The process equipment is located in two parallel canyons – a "Hot" and a "Warm" Canyon, separated by a central operating and service section that is divided into four levels. The more highly radioactive processing operations are performed in the Hot Canyon.

The HB-Line facility is classified as Hazard Category 2 and is comprised of a hardened structure located on the Fifth and Sixth Levels of the H-Canyon, a one-story office building appendage located on the Fifth Level of the H-Canyon, and a segregated area (outside the hot and warm canyons) in the southwest corner of the H-Canyon Third and Fourth Levels. The hardened structure and the office building are commonly referred to

as the new HB-Line. The segregated area on the Third and Fourth Levels of H-Canyon is commonly referred to as the old HB-Line. The HB-Line is a large radiochemical processing facility that processes solid scrap material; conducts receipt, storage, unpackaging and repackaging of uranium material in scrap recovery; and processes radioactive solutions containing neptunium, plutonium and/or uranium.

The H-Canyon Exhaust Ventilation System is considered as the final confinement barrier for airborne contamination for the Hot and Warm Canyons. The functional requirement of the active confinement ventilation system is to provide a filtered ventilation pathway to mitigate radioactive releases. It is credited with limiting the spread of contamination from the Canyons, providing a high degree of filtration of the Canyon Exhaust, providing an elevated release point for the exhaust, and protecting facility workers during abnormal and normal events. The Safety Class (SC) designated Canyon Ventilation System controls the spread of contamination in the Hot and Warm Canyons by ensuring that air flows from lesser contaminated areas to more contaminated areas and by filtering this air through sand filters before exhausting it to the atmosphere.

The HB-Line ventilation system directs air from radiological clean areas to areas with increased potential of radiological contamination. The HB-Line ventilation systems interface with the process vessels, process cabinets, and facility structure to control airborne radioactivity and other hazardous materials. The ventilation system features a once-through airflow. All exhaust air from HB-Line is passed through the H-Canyon exhaust system. The final level of confinement is the H-Canyon Sand Filter and the building itself, which constitute the confinement barrier between the general public and the nuclear material. The HB-Line Building Structure (outside walls, exterior security doors, roofs, exterior ventilation tunnel and Sixth Level Floor), and the Ventilation Interlock (Building Vacuum) are classified as SC Structure, Systems and Components (SSCs).

3.0 REVIEW RESULTS

3.1 Derivation of Ventilation System Performance Criteria and Confinement Strategy

The SRS H-Canyon and HB-Line Ventilation System Evaluation Report appropriately followed the process outlined in the 2004-2 Ventilation System Evaluation Guide in developing the Data Collection Table used to identify accidents, their unmitigated consequences, and the confinement strategy. Functional classification was performed in accordance with Procedure 2.25 of WSRC Procedure Manual E7, which meets the requirements of the DOE-STD-3009-94.

The H-Canyon active CVS is functionally classified as SC. The only Safety Significant (SS) portion of the ventilation system is the 291-H Stack and Stack Liner. All structural components are functionally classified as Performance Category (PC-3). The Stack is classified as PC-2. The H-Canyon confinement supply and exhaust systems, sand filter, and the passive confinement in both facilities are credited as SC to protect the public and control releases that may exceed or challenge the 25-rem Evaluation Guideline (EG) specified in DOE-STD-3009. These SC SSCs also provide an SS function to protect the

Co-located Worker and control releases that may exceed or challenge the 100-rem evaluation criteria. Unique and bounding accident scenarios for which the H-Canyon SC CVS is credited to mitigate are evaluated in the H-Canyon SAR and the HB-Line SAR. The Facility Evaluation Team (FET) performing the ventiliation system review concluded that the ventilation systems are appropriately classified as SC.

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

3.2 Evaluation of Ventilation System Against the Selected Performance Criteria

The FET evaluated the ventilation systems performance capabilities against the SC criteria specified in the 2004-2 Evaluation Guide The SRS H-Canyon and HB-Line Ventilation System Evaluation Report included a brief description of how the ventilation systems met the criteria and specified reference documents used as part of the review. As part of the evaluation, the ventilation and support systems were walked down and documentation was reviewed to confirm system configuration. The systems were then evaluated against the criteria and gaps were identified and documented.

The H-Canyon and HB-Line Ventilation System Evaluation Report identified three gaps with respect to the DNFSB 2004-2 Evaluation Guidance affecting four of the H-Canyon evaluation criteria and five of the HB-Line evaluation criteria. The first gap is that although H Canyon 291 H Stack will withstand the PC-3 seismic loads, the brick stack liner will collapse and partially or completely block airflow through the stack. The canyon building remains intact with minor cracks in the walls. The 243-19H Diesel Generators will provide power for the exhaust system after an earthquake. The safety analysis assumes that any one of four fans can be returned to operation within 48 hours, thereby pulling a minimum vacuum on the canyon.

The second gap is that the H-Canyon stack will fail in a Design Basis Tornado (DBT) or wind event. The Canyon and HBL structures will withstand a DBT or wind event, so there are no releases inside the structure and no accident event recognized in the SAR. High winds or tornado events causing failure of the 291-H stack would not simultaneously cause accidents inside the canyon, nor would there be credible accident scenarios whereby events inside the canyon would occur immediately after collapse of the stack.

The third gap is that some temporary release of unfiltered air is anticipated during fire events in HB-Line due to release of large volumes of Halon and abrupt expansion of air due to heat input. However, passive confinement features keep consequences well below EG. For fire events on 5th and 6th levels, the non-credited room exhaust fans, which discharge into the canyon exhaust tunnel, are conservatively assumed to fail. Although the canyon exhaust system continues to draw some air from HB-Line, it is not sufficient to avoid some release of unfiltered air through expansion joints and open doors. For fire events on the 3rd and 4th levels, non-credited air supply fans are conservatively assumed to continue to operate while the non-credited exhaust fans, which discharge into the warm canyon are conservatively assumed to fail.

The IRP concluded that evaluation of the ventilation systems against the 2004-2 Ventilation System Evaluation performance criteria was appropriately performed.

3.3 Evaluation of physical modifications to enhance safety performance

Options were identified for modification or replacement of the stack/stack liner. An evaluation was completed to provide Alternative Study Estimates for the Modification of the 291-H Stack to determine the most cost-effective path forward to modify the stack to meet PC-3 seismic and wind requirements. Options vary in cost, between $2,000,000 and $6,000,000. Another alternative to be evaluated is whether sufficient air can pass through the stack liner or stack rubble to maintain minimum facility vacuum. Of the four options explored, installing additional reinforcement is favored technically. Upgrades are currently included in the multi-year plan for facility infrastructure upgrades. The H-Canyon SAR is currently being revised to a 10 CFR 830 compliant Documented Safety Analysis (DSA) per current Office of Environmental Management guidance. The revision will consider revising the earthquake accident analysis to reduce/eliminate the assumed time that the active ventilation system is unavailable after an earthquake.

A pre-conceptual estimate for the HB-Line upgrades to close the third gap is $5,000,000 to $10,000,000 million. The HB-Line DSA is scheduled to be updated to improve alignment with DOE-STD-3009-94 requirements. The current accident analyses include many very conservative assumptions, and reanalysis will focus on which assumptions are warranted. The HB-Line mission is changing. There are no remaining plutonium solutions in H-Canyon, and neptunium processing was scheduled to be completed by the end of CY 2007. Further, new security restrictions will significantly lower allowable radioactive material inventory if plutonium oxide is declared Attractiveness Category 1 rather than 2. The DSA analysis has been completed since the completion of this report and is currently in review by DOE.

The SRS FET recommends that the H-Canyon Safety Basis upgrade, currently underway, identify if system upgrades are warranted to resolve the two gaps dealing with the stack/stack liner. The FET also concurs with the prudent H-Canyon decision to include the stack/stack liner upgrades in the list of upgrades that require funding to support new missions. Conceptual studies have been done that evaluate several upgrade options that cost between $2,000,000 and $6,000,000. For the third gap, the FET recommends that the HB-Line Safety Basis upgrade identify if systems upgrades are warranted to resolve the gaps. Any gap resolution will be considered during the DSA review/approval process. A pre-conceptual estimate for the HB-Line upgrades is $5,000,000 to $10,000,000.

The IRP concluded that SRS evaluation of the physical modifications was appropriately performed in accordance with the 2004-2 Ventilation System Evaluation Guide.

4. CONCLUSIONS

IRP concludes that the H-Canyon and HB-Line Facilities Evaluation Report was performed in accordance with the criteria in the DNFSB 2004-2 Ventilation System Evaluation Guide.

5. REVIEW TEAM MEMBERS

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

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

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

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

INDEPENDENT REVIEW

OF

L Material Storage Facility Disassembly Basin Section Ventilation System Evaluation Report

August 2009

Executive Summary

The Defense Nuclear Facilities Safety Board (DNFSB) Recommendation 2004-2 Independent Review Panel (IRP) reviewed the Savannah River Site (SRS) L Material Storage Facility (MSF) Disassembly Basin Section Ventilation System Evaluation Report utilizing the process and criteria outlined in Department of Energy's *Ventilation System Evaluation Guidance for Safety-Related and Non-Safety-Related System* (2004-2 Ventilation System Evaluation Guide).

The L Area MSF is a Hazard Category 2 facility used for underwater and dry storage of spent nuclear fuel (in the Disassembly Basin [DB] section of the facility). There is no confinement ventilation system for DB section. Historically, the DB ventilation system was used for personnel comfort and functionally classified as General Service but is currently inoperable. The L Area MSF Documented Safety Analysis credits other safety class and safety significant controls for preventing and mitigating accidents.

The Facility Evaluation Team (FET) performing the ventilation system review evaluated the ventilation system functional classification and determined it to be appropriately classified as General Service. The FET evaluated the cost and safety benefit of modifying the facility to have an active confinement ventilation system and concluded that the cost of modifying the facility (estimated $20 million cost) was not warranted because there was very little safety benefit to be gained given that accidents were prevented or mitigated by other safety controls.

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

Results of Independent Review Panel's Review of the L Material Storage Facility Disassembly Basin Section Ventilation System Evaluation Report

1. INTRODUCTION

The Defense Nuclear Facilities Safety Board (DNFSB) Recommendation 2004-2 Independent Review Panel (IRP) reviewed the Savannah River Site (SRS) L Material Storage Facility Disassembly Basin Section Ventilation System Evaluation Report utilizing the process and criteria outlined in Department of Energy's (DOE's) *Ventilation System Evaluation Guidance for Safety-Related and Non-Safety-Related System* (2004-2 Ventilation System Evaluation Guide).

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

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

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

2. FACILITY AND VENTILATION SYSTEM OVERVIEW

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

The DB section has been modified and now primarily serves as a storage location for spent nuclear fuel. SRS plans to continue receiving spent nuclear fuel from research reactors and other miscellaneous nuclear material and storing it in the DB section until

alternative interim storage facilities are available or final disposition of the material can be accomplished.

The majority of the fuel stored in the DB section is stored underwater. A small quantity of fuel is stored dry in the Dry Fuel Storage Area (DFSA) and in the Dry Cave. The DFSA is a totally enclosed, isolated area within the DB section for the dry storage of fuel. The DFSA was designed as a critically safe and environmentally sound location for the dry storage of special nuclear material. The DFSA provides an effective four hour fire rated barrier wall.

There is no confinement ventilation system for the DB section of the L Area MSF. The primary ventilation fan for the DB section is out of service and inoperable. The DB section ventilation system is used for personnel comfort and is functionally classified as General Service.

3.0 REVIEW RESULTS

3.1 Derivation of Ventilation System Performance Criteria and Confinement Strategy

The L Area MSF has been identified as a Hazard Category 2 facility. The Facility Evaluation Team (FET) performing the ventilation system review evaluated the ventilation system functional classification to determine whether it was appropriately classified as General Service or should be classified at a higher classification level (e.g., safety significant or safety class). The FET found that with current credited controls in place, radiological doses to the worker and to the public are significantly below minimum Evaluation Guides (EGs) required to establish additional safety significant or safety class controls per WSRC E7 Manual, Procedure 2.25, *Functional Classification.* Based on this, the FET concluded that the current General Service classification was appropriate.

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

3.2 Evaluation of Ventilation System Against the Selected Performance Criteria

Because no confinement ventilation system existed for the DB section, the FET did not perform a formal evaluation of the system against the 2004-2 Ventilation System Evaluation Guide to evaluate specific system performance gaps but rather performed an evaluation of the cost and benefit of installing a complete confinement ventilation system.

The IRP concluded that the evaluation was not necessary to indicate the complete absence of a ventilation system.

3.3 Evaluation of physical modifications to enhance safety performance

The cost range of a confinement ventilation system for the DB section using an estimate prepared by Site Estimating was $20,000,000. The FET recommended no facility modifications be made because:

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

The IRP concluded that SRS evaluation of the physical modifications was appropriately performed in accordance with the 2004-2 Ventilation System Evaluation Guide.

4. CONCLUSIONS

IRP concludes that the SRS L MSF DB Section Ventilation System Evaluation was performed in accordance with the criteria in the DNFSB 2004-2 Ventilation System Evaluation Guide.

5. REVIEW TEAM MEMBERS

James O'Brien, IRP Chairman, Office of Health, Safety and Security
Robert Nelson, IRP Member, Office of Environmental Management

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

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

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

INDEPENDENT REVIEW

OF

Savannah River Site (SRS) Outside Facilities – H Ventilation System Evaluation Report

July 2009

Executive Summary

The DNFSB Recommendation 2004-2 Independent Review Panel (IRP) reviewed the Savannah River Site (SRS) Outside Facilities – H Ventilation System Evaluation Report utilizing the process and criteria outlined in DOE's *Ventilation System Evaluation Guidance for Safety-Related and Non-Safety-Related System* (2004-2 Ventilation System Evaluation Guide).

The SRS Outside Facilities - H are Hazard Category 2 facilities located in the 200-H Separations Area of the SRS. Operations conducted in the Outside Facilities – H include general support for H canyon activities, principally for processing of irradiated and unirradiated fuels and targets.

The Documented Safety Analysis (DSA) for the Outside Facilities - H does not credit any active or passive confinement ventilation systems for mitigation of accidents since these facilities exist outside the H Canyon facility with no physical structure surrounding them. There is a non-credited recycle vessel vent active confinement system that draws a slight vacuum on each vessel and discharges to a sand filter. The radioactive source term contained in the vessels is low. The offsite Evaluation Guidelines and onsite evaluation criteria are not challenged for any of the bounding accidents analyzed in the DSA.

For the Outside Facilities – H there are no credited building structures and no credited confinement ventilation systems to evaluate.

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

Results of Independent Review Panel's Review of the Savannah River Site Outside Facilities – H Ventilation System Evaluation Report

1. INTRODUCTION

The DNFSB Recommendation 2004-2 Independent Review Panel (IRP) reviewed the Savannah River Site (SRS) Outside Facilities – H Ventilation System Evaluation Report utilizing the process and criteria outlined in DOE's *Ventilation System Evaluation Guidance for Safety-Related and Non-Safety-Related System* (2004-2 Ventilation System Evaluation Guide).

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

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

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

2. FACILITY AND VENTILATION SYSTEM OVERVIEW

The SRS Outside Facilities - H are Hazard Category 2 facilities located in the 200-H Separations Area of the SRS. Operations conducted in the Outside Facilities – H include general support for H canyon activities, principally for processing of irradiated and unirradiated fuels and targets.

The term "Outside Facilities" is used to describe a wide variety of processes and utilities that are ancillary to the primary 200-H Area operations. The Outside Facilities – H processes include A-Line, General Purpose Evaporation, Segregated Solvent facilities, and Enriched Uranium Storage (EUS) Tank which exist outside of H-Canyon without any supporting physical structure around them. Low Level Waste containers (e.g., Sealands, B-25s, B-12s, roll pans, and pot boxes) are also temporarily stored or staged at Outside Facilities – H in support of H-Canyon activities.

3.0 REVIEW RESULTS

3.1 Derivation of Ventilation System Performance Criteria and Confinement Strategy

The Facility Evaluation Team (FET) performing the ventilation evaluation reviewed the Facility hazard analysis and safety analysis. For all of the accident consequences identified in the SAR for the Hazard Category 2 Outside Facilities – H, all of the unmitigated radiological consequences are below the DOE Standard 3009 evaluation guidelines for the maximum exposed offsite individual (i.e., 25 rem) and the on site criteria for exposure to a collocated worker (i.e., 100 rem). Additionally, the unmitigated radiological consequences do not exceed the minimum evaluation guidelines required to establish safety significant defense-in-depth controls to protect the collocated worker and offsite public as defined in WSRC E7 Manual, Procedure 2.25. The accident analysis does not require a confinement ventilation system as a mitigator for any of the facility Design Basis Accidents since the unmitigated doses do not challenge the current control selection evaluation guidelines.

The IRP concluded that the FET appropriately reviewed the safety classification of the facility and the requirement for a confinement ventilation system as specified in the 2004-2 Evaluation Guide.

3.2 Evaluation of Ventilation System Against the Selected Performance Criteria

For the Outside Facilities – H, there are no credited building structures and no credited confinement ventilation systems to evaluate. There is a non-credited vent system that draws a slight vacuum on each vessel and discharges to the H-Canyon sand filter and exhaust stack. The Outside Facilities – H are located out of doors because the source term contained in the vessels is low. Due to low unmitigated radiological doses, the Outside Facilities – H operate without a credited confinement structure and without a credited confinement ventilation system.

The IRP concluded that no ventilation system existed for these facilities for evaluation against the 2004-2 Ventilation System Evaluation performance criteria.

3.3 Evaluation of physical modifications to enhance safety performance

The FET concluded that, based upon the low radiological doses to the public and workers from postulated design basis accidents and the high cost of constructing a confinement structure and confinement ventilation system for multiple facilities (A-Line Facility, General Purpose Evaporator Facility, and the Segregated Solvent Facility), no modifications should be made to the Outside Facilities – H at this time. However, the Safety Basis upgrade, that is currently underway, may conclude that additional Safety Basis controls (including perhaps ventilation controls) are warranted.

4. CONCLUSIONS

IRP concludes that the SRS Outside Facilities - H Ventilation Systems Evaluation Report was performed in accordance with the criteria in DNFSB 2004-2 Ventilation System Evaluation Guide.

5. REVIEW TEAM MEMBERS

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

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

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

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

INDEPENDENT REVIEW

OF

Savannah River Site (SRS) Solid Waste Management Facilities Hazardous and Mixed Waste Storage Ventilation System Evaluation Report

October, 2009

Executive Summary

The Defense Nuclear Facilities Safety Board (DNFSB) Recommendation 2004-2 Independent Review Panel (IRP) reviewed the Savannah River Site (SRS) Solid Waste Management Facilities Hazardous and Mixed Waste Storage Buildings Ventilation System Evaluation report utilizing the process and criteria outlined in Department of Energy's *Ventilation System Evaluation Guidance for Safety-Related and Non-Safety-Related System* (2004-2 Ventilation System Evaluation Guide).

Three N Area Hazardous Waste Management Storage Buildings, 645-N, 645-2N and 645-4N are addressed in this evaluation. The facilities collectively comprise a Hazard Category 3 segment. None of these buildings possess an active or passive airborne release confinement system.

In accordance with the 2004-2 Ventilation System Evaluation Guide, the facilities were evaluated against Defense in Depth criteria to determine if there is a need for active confinement ventilation systems. The review concluded that there was not a need for an active confinement ventilation system because consequences from analyzed events would not warrant either a safety significant or a safety class ventilation system and the cost associated with modifications to install a defense in depth system were not cost beneficial.

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

Results of Independent Review Panel's
Review of the Savannah River Site (SRS) Solid Waste Facilities
Hazardous and Mixed Waste Storage Buildings
Ventilation System Evaluation Report

1. INTRODUCTION

The Defense Nuclear Facilities Safety Board (DNFSB) Recommendation 2004-2 Independent Review Panel (IRP) reviewed the Savannah River Site (SRS) Solid Waste Facilities Hazardous and Mixed Waste Storage Buildings Ventilation System Evaluation Report utilizing the process and criteria outlined in Department of Energy's (DOE's) *Ventilation System Evaluation Guidance for Safety-Related and Non-Safety-Related System* (2004-2 Ventilation System Evaluation Guide).

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

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

The IRP team reviewed the SRS Solid Waste Facilities Hazardous and Mixed Waste Storage Buildings Ventilation System Evaluation report to determine whether it was performed in accordance with the 2004-2 Ventilation System Evaluation Guide; evaluate the appropriateness of the evaluation results and methods proposed for eliminating identified gaps, if any, between the existing ventilation system and applicable performance criteria; and provide any additional input considered appropriate to the responsible program and site offices.

2. FACILITY AND VENTILATION SYSTEM OVERVIEW

The three Hazardous Waste Management Storage Buildings (545-N, 645-2N, and 645-4N) are located within the plant northwest quadrant of N-Area. Each building has been permitted by the South Carolina Department of Health and Environmental Control to provide interim storage of containerized Mixed Waste and/or Hazardous Waste, Low Level Waste, RCRA empty containers, TSCA waste, and non-hazardous waste. The inventories in the buildings are maintained as Hazard Category 3. Buildings 645-N, 645-2N, and 645-4N are segregated into one or more cells (or bays) and are used to provide interim storage of waste in containers as specified in the current Resource Conservation and Recovery Act permit. These vented metal buildings provide weather shelter for the waste containers. The containers are stored on concrete pads that have surface liquid containment curbs around each side.

Operation of these buildings includes the handling, sampling, storage, repackaging, lab packing, sorting, and inspection of hazardous waste and mixed waste containers. Only waste that meets the requirements of the Washington Savannah River Company (WSRC) Manual 1S Waste Acceptance Criteria (WAC) or have approved WAC deviations is received. Containers meeting the WAC are transported into the storage building, typically via forklift. The containers may then be re-palletized for space optimization and placed into the proper storage location as directed by the receipt procedure. Waste storage procedures do not permit incompatible wastes to be stored in the same cell. Hazardous and mixed wastes are stored within the buildings until shipped offsite.

Buildings 645-N, 645-2N and 645-4N do not have a Confinement Ventilation System (CVS) installed. The current DOE-approved, implemented Solid Waste Management Facility (SWMF) DSA and the draft SWMF DSA Upgrade have not identified the need for or credited a CVS to mitigate onsite or offsite radiological exposure consequences from accidents that may occur. Radiological inventory is limited in these Hazard Category 3 buildings by the Technical Safety Requirements such that releases from these buildings due to accidents analyzed in the DSAs do not pose an undue risk to onsite workers or the public, i.e., offsite Evaluation Guides and onsite evaluation criteria specified in WSRC E7 Procedure 2.25 are not challenged.

3.0 REVIEW RESULTS

3.1 Derivation of Ventilation System Performance Criteria and Confinement Strategy

The SRS Solid Waste Facilities Hazardous and Mixed Waste Storage Buildings ventilation evaluation appropriately followed the process outlined in the 2004-2 Ventilation System Evaluation Guide in developing the Data Collection Table used to identify accidents, their unmitigated consequences, and the confinement strategy based upon the existing DSA and draft DSA Upgrade for Buildings 645.N, 645-2N, and 645-4N. The draft DSA Upgrade analysis bounds that in the current DOE-approved and implemented DSA.

The draft DSA Upgrade analyzed a bounding combustible organic liquid fire in Hazard Category 3 facilities including the subject buildings. The unmitigated event resulted in a dose to the 100-meter worker of 269 rem and an offsite dose to the Maximally Exposed Offsite Individual of 0.14 rem. Both the offsite and onsite (100-meter) doses were calculated using 95th percentile meteorology. The MOI consequence did not challenge the offsite Evaluation Guide so no Safety Class preventative or mitigative controls were specified. The onsite worker dose, which exceeded the worker evaluation criteria, is mitigated to approximately 77 rem by a Technical Safety Requirement inventory limit, which serves a Safety Significant function. Since the Technical Safety Requirements inventory limit reduced the worker consequence to less than the evaluation criteria, additional Safety Significant controls, such as a CVS, were not specified by the DSA accident analysis. Additional conservatisms that would further reduce the expected dose include the fact that individual waste containers stored in these buildings normally have a very low radiological content compared to the full Hazard Category 3 inventory

authorized for these buildings cumulatively. In fact, since the waste in these buildings is typically bulk contaminated combustible liquid, the DSA Upgrade will limit these buildings to no more than 16 Plutonium Equivalent Curies (PEC) each. Additionally, the DSA Upgrade will limit individual containers that could be opened within 645-N, -2N, and -4N to no more than 4 PEC. Thus, the 100-meter worker hazard from a fire involving one of these containers would be much less than the mitigated dose of 77 rem (approximately 20 rem). Dose mitigation would be further enhanced by SRS fire fighting and emergency response actions that would be initiated upon a fire.

If a CVS were to be installed in the subject buildings, it would serve as a Defense in Depth (DID) safety function since the 100-meter worker has already been mitigated to less than the evaluation criteria. A CVS that utilized HEPA filtration operating at 99.97% minimum efficiency would further reduce the worker dose to well below 1 rem, assuming that the CVS continues to operate during the fire accident. However, a DID CVS is not required to withstand a credible fire event according to the Ventilation System Evaluation Guidance.

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

3.2 Evaluation of Ventilation System Against the Selected Performance Criteria

The SRS Solid Waste Facilities Hazardous and Mixed Waste Storage Buildings ventilation report evaluated the building confinement ventilation systems utilizing the Defense in Depth (DID) criteria from the 2004-2 Ventilation Evaluation Guide. Since the SRS Solid Waste Facilities Hazardous and Mixed Waste Storage Buildings do not contain an installed CVS, the result was a Table 5.1 containing gaps for all of the criteria. Two options were further evaluated, both of which are designed and estimated to close all of the gaps. Option 1 included the design and installation of CVSs in each of the three buildings. Option 1 includes the design and installation of a structure with primary and secondary confinements inside one of the buildings.

The IRP concluded that evaluation of the ventilation systems against the 2004-2 Ventilation System Evaluation performance criteria was appropriately performed.

3.3 Evaluation of physical modifications to enhance safety performance

For Option 1, each building has its own CVS designed to ensure the system and facility meet the DNFSB 2004-2 criteria in accordance with all applicable requirements. A Rough-Order-of-Magnitude estimate to install a CVS in the three buildings is $11,200,000 ($7,800,000 to $16,800,000). This CVS is not required by the Evaluation Guidance to meet the criterion for withstanding credible fire events. However, the analyzed accident scenario is a full facility fire. Since the building serves as the primary confinement zone for this option, it must be protected. According to the DOE-HDBK-1169, Section 10 Fire Protection, a suppression system should be installed for each building to mitigate building and ductwork damage. In addition, the HEPA filters should be made of noncombustible materials with water sprays as required and a fire detection system installed in filter housings. Installing a fire suppression system in each of the

buildings could increase the cost by as much as three times depending on the choice of suppression technology.

Option 2 includes the design and installation of a structure inside one of the N area buildings with primary and secondary confinements. The design and estimate is based on the Mixed Waste Processing Facility (MWPF) which is currently installed on TRU Pad 6 in E-Area. The MWPF TEC was estimated in 2001 at $1,500,000. This estimate adjusted for escalation to 2007 dollars and TPC is $2,500,000. Using this as the basis for Option 2, a Rough-Order-of Magnitude estimate to close all the gaps is $1,800,000 to $3,800,000.

The third option evaluated, Option 3, was the current operation. Operations to open containers are performed in a temporary radiological containment system, e.g., a ventilated plastic hut that meets WSRC 5Q requirements. Container opening operations are typical only infrequently performed within the buildings. Additionally, the DSA upgrade will limit individual containers that could be opened within the buildings to no more than 4 PEC. Thus, the 100-meter worker hazard form a fire involving one of these containers would be much less than the mitigated dose of 77 rem (approximately 20 rem). Dose mitigation would be further enhanced by SRS fire fighting and emergency response actions that would be initiated upon a fire.

The SRS Facility Evaluation Team (FET) recommends the use of Option 3. The FET believes the low operational risk normally involved with open container processing does not justify the expense of either Options 1 or 2 and the low risk is appropriately managed by Option 3.

The IRP concluded that SRS evaluation of the physical modifications was appropriately performed in accordance with the 2004-2 Ventilation System Evaluation Guide.

4. CONCLUSIONS

IRP concludes that the SRS Solid Waste Facilities Hazardous and Mixed Waste Storage Buildings evaluation was performed in accordance with the criteria in the DNFSB 2004-2 Ventilation System Evaluation Guide.

5. RECOMMENDATIONS

The IRP recommends that the Program Secretarial Office and Central Technical Authority accept the SRS Solid Waste Facilities Hazardous and Mixed Waste Storage Buildings Ventilation System Evaluation.

6. REVIEW TEAM MEMBERS

James O'Brien, IRP Chairman, Office of Health, Safety and Security
Robert Nelson, IRP Member, Office of Environmental Management

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

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

For the SRS Solid Waste Facilities Hazardous and Mixed Waste Storage Buildings evaluation, a detailed-full IRP team review was not determined to be necessary.

INDEPENDENT REVIEW

OF

Savannah River National Laboratory Active Confinement Evaluation Report

November 2009

Executive Summary

The Defense Nuclear Facility Safety Board (DNFSB) Recommendation 2004-2 Independent Review Panel (IRP) reviewed the Savannah River National Laboratory (SRNL) Active Confinement Evaluation Report utilizing the process and criteria outlined in Department of Energy's (DOE's) *Ventilation System Evaluation Guidance for Safety-Related and Non-Safety-Related System* (2004-2 Ventilation System Evaluation Guide).

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

Based on SRS Evaluation Criteria, the FET identified six events that exceeded the 1 rem criteria for the Maximally Exposed Offsite Individual (MOI). No events were identified that exceed the 100 rem criteria for the Co-located Worker (CS). Subsequent application of guidance from the 2004-2 Ventilation System Evaluation Guide screening criteria along with DOE guidance to exclude Natural Phenomena Hazard (NPH) and full facility fire events resulted in the elimination of all but one event (glovebox over-pressurization). However, to develop a more complete understanding of the hazards that can be mitigated by an active confinement ventilation system as part of the assessment, the FET elected to include four additional process events. The FET performed a functional review of the 15 active ventilation systems using the Safety Class (SC) criteria per the DOE evaluation guidance.

The FET evaluation resulted in the identification of 58 gaps for further evaluation. All gaps were determined to not constitute a discrepancy between the DSA and field conditions. The FET determined that closure of all 58 gaps would require funding in the range of $37 M to $107 M over a period of 6 to 10 years depending upon gap closure methods selected. Based on the number and significance of the gaps as well as the estimated cost to close all the gaps, the FET recommends closing 24 of the 58 gaps at an estimated cost of $23 M to $33 M over a period of 4 to 6 years, contingent on funding. Closure of the gaps would provide a discernable improvement in the reliability and effectiveness of the existing integrated active confinement ventilation system for protection of the facility worker and provide a system that could be credited in the future for protection of the co-located worker, and in turn enhanced protection of the public.

The IRP concludes that the SRNL Active Confinement Evaluation was performed in accordance with the criteria in the DNFSB 2004-2 Ventilation System Evaluation Guide.

Results of Independent Review Panel's
Review of the Savannah River National Laboratory Active Confinement Evaluation Report

1. INTRODUCTION

The Defense Nuclear Facility Safety Board (DNFSB) Recommendation 2004-2 Independent Review Panel (IRP) reviewed the Savannah River National Laboratory (SRNL) Active Confinement Evaluation Report utilizing the process and criteria outlined in Department of Energy's (DOE's) *Ventilation System Evaluation Guidance for Safety-Related and Non-Safety-Related System* (2004-2 Ventilation System Evaluation Guide).

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

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

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

2. FACILITY AND VENTILATION SYSTEM OVERVIEW

The main laboratory of the SRNL, is a nominal 250,000 square foot Hazard Category 2 Nuclear facility. It is divided into six sections or wings (Sections A through F). Each section has a minimum of two levels – the main floor and the service floor.

- Section A is an administrative portion of the facility and has no radionuclide or chemical inventory with the exception of exempt sealed sources (used by the Radiological Protection Department to source test equipment). This section has a third floor consisting of office space.
- Sections B and C consist of radiochemical laboratories and office space on the main floor and radiochemical labs, two Intermediate Level Cells, administrative spaces, and mechanical and electrical support equipment on the service floor. A sub-basement in each Service Floor contains the majority of the confinement ventilation system exhaust fans.
- Section D consists of offices, maintenance shops, chemical and laboratory supply and storage areas, robotics laboratory, glass shop and high bay experimental area.

- Section E contains two High Level Cell Blocks A and B as well as the associated support areas necessary to support operations of the cells.
- Section F contains operating laboratories, shielded cell facilities, several "retired" process areas waiting D&D and a high bay experimental area.
- The majority of the air exhausted from Sections E and F and a portion of the air exhausted form Sections B and C discharge to the SRNL Sand Filter for additional filtration before release to the environment.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

3.0 REVIEW RESULTS

3.1 Derivation of Ventilation System Performance Criteria and Confinement Strategy

The confinement ventilation systems for the Hazard Category 2 SRNL Building 773-A are not credited in the design basis accident analyses for providing radiological dose reduction for the offsite and onsite receptors. Therefore, the mitigated and unmitigated dose to the Maximally Exposed Offsite Individual (MOI) and Co-located Worker (CW) are the same. However, some of the confinement ventilation systems for Building 773-A are functionally classified as Safety Significant to protect in-facility workers form potential radiological hazards from explosion events involving accumulation of process or distributed flammable gas. The balance of the ventilation and support systems are functionally classified as General Service. The Facility Evaluation Team (FET) concluded that the SS functional classification of several confinement ventilation systems for protection of the facility worker and GS functional classification of the balance of the confinement ventilation systems are appropriate.

Using the 2004-2 Evaluation Guide criteria, six events were identified that exceed the SRS 1 rem criteria for the MOI. Of those six events, five involve an NPH initiator or a full facility fire which were excluded. However, to develop a more complete understanding of the hazards that can be mitigated by an active confinement ventilation system, the FET elected to include four additional events from the original hazards analysis.

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

3.2 Evaluation of Ventilation System Against the Selected Performance Criteria

The FET conservatively utilized the Safety Class (SC) performance criteria in the evaluation guidance to perform a functional review of the 15 ventilation systems serving the four sections of Building 773-A. Since the SC performance criteria are used, the evaluation and identification of any associated gaps would not change if meteorological conditions were changed from 50% to 95% for the CW.

A multiple page cross-cut matrix of the 58 identified gaps by system and criteria was provided in the evaluation report with the basis provided in the work sheets attached to the report. The FET grouped and split the gaps across systems and criteria based on the following considerations.

In some cases, gaps have been combined across system boundaries where closure of the same criteria for multiple systems would need to be executed together to have the desired outcome. In other cases, the same gap across multiple system boundaries has been evaluated separately since the priority for closing a gap may be different based on the consequence and likelihood of a specific event in a specific location.

The IRP concluded that evaluation of the ventilation systems were conservatively performed against the 2004-2 Ventilation System Evaluation performance criteria.

3.3 Evaluation of physical modifications to enhance safety performance

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

- Does the gap identify a discrepancy between the DSA and field conditions?
- Is the gap associated with a primary, secondary or tertiary confinement system?
- Could closing the gap decrease the probability of an event form occurring?
- Could closing the gap provide the ability to mitigate an event form Low to Negligible consequence level?
- Would closing an alternative gap provide the same or better mitigation of an event at a lower cost?
- In the process in the primary confinement zone active or shutdown?
- The number of active process areas affected by the gap.

The recommendation and priority to close individual gaps is summarized in Table 3 of the Evaluation Report and high/low cost estimates are presented in Table 4 of the Evaluation Report. A cross-walk of gaps recommended for closure which reduce the potential or mitigate the consequence of the five evaluated process events is provided in an attachment to the Evaluation Report. A summary of Table 3 of the Evaluation Report is as follows:

- Overall 24 of 58 gaps are recommended to be closed.
- No gaps are identified that constituted a discrepancy between the DSA and field conditions.
- 23 gaps are related to a primary confinement zone. Of these gaps, 15 are recommended to be closed.
- 25 gaps are related to a secondary confinement zone. Of these gaps, 14 are recommended to be closed.
- 31 gaps are related to a tertiary confinement zone. Of these gaps, we are recommended to be closed.
- 8 gaps could decrease the probability (prevent) of the Low consequence events to Negligible. Of these gaps, 7 are recommended to be closed.
- 9 gaps could decrease the probability (prevent) of a Negligible consequence event. Of these gaps, all 9 are recommended to be closed.
- 8 gaps could increase the ability of the existing system to mitigate of a Low consequence event to Negligible. Of these gaps, 7 are recommended to be closed.

- 36 gaps could increase the ability of the existing system to mitigate a Negligible consequence event. Of these gaps, 18 are recommended to be closed.
- 16 gaps are not recommended for closure based upon the FET's evaluation that closure of an alternative gap would also mitigate this gap.
- 3 of the gaps identified dealt with inactive facilities. None of these gaps are recommended to be closed.

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

The cost range to close all the gaps is between $37 M and $107 M depending upon the gap closure method selected. The cost range to close the recommended gaps using the method recommended is between $23 M and $33 M.

The IRP concluded that SRS evaluation of the physical modifications was appropriately performed in accordance with the 2004-2 Ventilation System Evaluation Guide.

4. CONCLUSIONS

IRP concludes that the SRNL Active Confinement Evaluation Report was performed in accordance with the DNFSB 2004-2 Ventilation System Evaluation Guide.

5. RECOMMENDATIONS

The IRP recommends that the Program Secretarial Office and Central Technical Authority accept the SRNL Active Confinement Evaluation Report.

6. REVIEW TEAM MEMBERS

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

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

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

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