INDEPENDENT REVIEW PANEL

REPORT

NEW WASTE CALCINING FACILITY VENTILATION SYSTEM PILOT EVALUATION

January 2007

BACKGROUND

On December 7, 2004, the Defense Nuclear Facilities Safety Board (DNFSB) issued Recommendation 2004-2, *Active Confinement Systems*. Recommendation 2004-2 noted concerns with the safety system (safety-class or safety-significant) designation strategy utilized in or planned for several facilities to confine radioactive materials during or following accidents. The Board's main issue is that for the purpose of confining radioactive materials through a facility-level ventilation system, safety system designation should be based on the active safety function (forced air through a HEPA filter system). The DNFSB is concerned that a passive confinement safety function may not be as effective as the active safety function in a few postulated accident scenarios.

On March 18, 2005, the Secretary accepted DNFSB Recommendation 2004-2. On August 22, 2005, the Department of Energy (DOE) forwarded its Implementation Plan (IP) for this recommendation to the DNFSB. The DNFSB accepted the Department's IP on September 19, 2005. The DOE IP proposed a methodology for systematically reviewing the ventilation systems at each of the sites. That methodology was established as the *Ventilation System Evaluation Guidance for Safety-Related and Non-Safety-Related Systems*. The evaluation process was first piloted at several facilities prior to DOE-wide implementation. This IRP review is of one of these pilot evaluations. Timing of this evaluation, review, and closure of identified gaps is in accordance with the DOE revised Implementation Plan forwarded to the DNFSB on July 12, 2006.

FACILITY OVERVIEW

The New Waste Calcining Facility (NWCF) is categorized as a Hazard Category 2 nuclear facility based on the total quantity of nuclear material that could be available for an unmitigated release. The facility began hot operations in 1982. Until June of 2002, the primary mission of the NWCF was to convert radioactive liquid waste into a granular solid called calcine and to destroy waste process solvents by using them as a combustion fuel in the calcine process. The calcination process is now closed in accordance with Resource Conservation and Recovery Act (RCRA) regulations. There are no plans to restart calcining. Now the primary missions of the MWCF are concentrating waste solutions using the Evaporator Tank System (ETS), filter leaching, and characterizing and processing remote-handled (RH) transuranic (TRU) waste for shipment to the Waste Isolation Pilot Plant (WIPP).

The NWCF building has three main levels – one above grade and two below grade – and two main areas, the decontamination area and the calciner area. Process control takes place above grade, while the evaporation of liquid waste and filter leaching takes place below grade on the second and third levels. Decontamination area activities, which include RCRA-regulated debris treatment and RH TRU characterization and processing, are conducted above grade on the first level and below grade on the second level. The closed calciner process equipment, ETS, associated process vessels, filter leaching cell, and equipment handling radioactive effluent are housed below grade on the second and third levels – in reinforced concrete cells or cubicles – to provide environmental and personnel protection (such as confinement and attenuation of radioactive fields).

There are four active processes at the NWCF. These include Liquid Waste Evaporation, Filter Leaching, Decontamination and Debris Treatment, and RH TRU Characterization.

The NWCF is designed to provide isolation and containment of radioactive material through multiple layers of confinement (primary, secondary, and tertiary confinement).

The process vessels, the associated piping, and the process off gas system, which exhausts the process vessels, provide the primary confinement barrier. This primary confinement provides isolation of radioactive materials during normal operations. The process cells and the associated heating and ventilation systems, which together enclose the primary system, provide the secondary confinement barrier. The building and the facility ventilation and filter system provide the tertiary confinement barrier. These confinement capabilities, including confinement barriers and associated ventilation systems, are designed to maintain a controlled, continuous airflow pattern from the environment into the confinement building (tertiary barrier), and then from areas with lesser contamination potential to areas with greater contamination potential (secondary barrier). The primary confinement is designed with a high degree of reliability to ensure that radioactive material will not leak into the secondary confinement system. However, if this should occur, the secondary confinements will contain and exhaust the potentially contaminated airflow through its filtration system to remove particulate activity prior to releasing the airflow to the environment.

INDEPENDENT EVIEW PANEL EVALUATION

The IRP was involved with the pilot study throughout the entire evolution of the evaluation of the New Waste Calcining Facility (NWCF). Multiple meetings were conducted involving participants from the Idaho SET, the IRP, and DNFSB Staff.

Initial evaluation of the Documented Safety Analysis (DSA) for the NWCF resulted in questions being raised with respect to the current status of the facility. The DSA for the NWCF had not been updated since the completion of the calcining mission. This mission has been ceased and will not be restarted. The pilot study did not have within it scope DSA upgrade requirements, but identification of this discrepancy will generate an update to the NWCF DSA at the earliest opportunity.

When the current missions and inventories were evaluated against the requirements of Table 4.3 for the pilot study (Attachment 1), it was documented that credit was no longer taken for any of the ventilation systems in any of the evaluated accidents at either a safety class (SC) or safety significant (SS) level. Representative accidents, along with the evaluated consequences were reviewed by the IRP and the IRP agreed with the final conclusion of the Site Evaluation Team (SET). The SET did identify the need for further documentation in the future to eliminate a leak path factor calculation which was used in one of the evaluations. In order to complete the total scope of the pilot study, the IRP recommended that in accordance with provisions of the Evaluation Guidelines, the study continue with the evaluation being completed against the SS criteria of the guidelines.

Subsequent evaluation of the NWCF by the ID SET against the SS evaluation criteria from the Evaluation Guidelines did not identify any gaps from the non discretionary criteria of the guidelines. This was generally the result expected by the ID SET since the facility ventilation systems were constructed and built to support the original high hazard calcining mission of the facility.

INDEPENDENT REVIEW PANEL RECOMMENDATION

The IRP recommends that the PSO and CTA accept the NWCF Pilot Study and its conclusions.

LESSONS LEARNED

The following lessons learned were provided by the ID SET.

The following are the lessons learned in performing the pilot ventilation system evaluation on the NWCF.

- The ventilation system walk down with the site evaluation team, facility evaluation team, and system engineer was important in understanding how the ventilation system is configured and in understanding its weaknesses and strengths. CWI and DOE-ID SSO's went over all the table 5.1 criteria as a group before the walk down. This helped focus the teams on what aspects of the system were credited by the SAR and what to look for.
- Team makeup is important. A safety analyst familiar with the facility safety basis and the system engineer for the ventilation system are important to providing a good evaluation.
- The site and facility evaluation teams worked well in performing the evaluation.
- It was very difficult if not impossible to provide a facility overview in 1 to 2 paragraphs and a ventilation confinement system overview in 2 to 3 paragraphs in the final report as recommended in the evaluation guidance document.
- It was difficult to complete the Table 5.3 evaluation within a month. Other facilities should start the evaluation as soon as possible and provide resources that can devote full time effort to completing the evaluation and writing the final report.
- It appears that some of the Table 5.1 criteria for safety significant only applies if a ventilation system is credited by the SAR. It appears the implication is that a facility could skip these criteria if ventilation is not credited.

The IRP agrees with the lessons learned provided above by the ID SET. The IRP would include an additional emphasis that facility safety bases need to be kept up to date with current missions. Strict use of the existing DSA at the time of the evaluation would have required a significantly different evaluation to be conducted.

Idaho Cleanup Project

New Waste Calcining Facility Ventilation System Pilot Evaluation

August 2006

REVIEWS AND APPROVALS

Facility Evaluation Team (See Attachment 1 for Bios)

8/30/06

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EXECUTIVE SUMMARY

U.S. Department of Energy (DOE), *Ventilation System Evaluation Guidance Document*, provides guidance for performing ventilation system evaluations in accordance with a plan that implements Defense Nuclear Facilities Safety Board (DNFSB) Recommendation 2004-2. Recommendation 2004-2 noted concerns with the confinement strategy utilized or planned for in several facilities to confine radioactive materials during or following accidents. The DNFSB prefers active confinement systems that rely on motive force and filters over passive confinement systems that use facility structures and components (e.g., facility enclosure without the motive force).

Per DOE's implementation plan, confinement ventilation system evaluations were performed for a small number of facilities identified as pilot facilities to validate the path forward for the remaining Hazard Category 2 and 3 facilities. The Idaho Nuclear Technology and Engineering Center (INTEC) New Waste Calcining Facility (NWCF) at the Idaho National Laboratory (INL) was designated as one of these pilot facilities.

The pilot evaluation for the NWCF was performed in three phases. Phase I involved data gathering using Table 4.3 of the DOE guidance document and was submitted to the DOE Independent Review Panel (IRP) for concurrence on June 29, 2006. Phase II involved ventilation system evaluations using DOE guidance document Table 5.1 and associated evaluation criteria and was submitted to the IRP for review on July 31, 2006. Phase III involved completion of the final evaluation report and submittal to the IRP. The final pilot evaluation report for the NWCF was transmitted to the DOE Program Secretarial Officer for review.

The NWCF is a Hazard Category 2 facility designed with a combination of passive structures and ventilation systems for contamination control and worker protection. The results of the hazard and accident analysis in the facility documented safety analysis (DSA) relies on the passive confinement features provided by the facility and does not credit safety-significant or safety-class confinement features. Therefore, functional requirements and performance criteria are not identified for any of the NWCF ventilation systems.

Per the evaluation guidance for Hazard Category 2 facilities, the performance criteria for safety-significant ventilation systems is used to evaluate the NWCF ventilation systems. The result of the evaluation is that the NWCF systems meet the nondiscretionary performance criteria for safety-significant ventilation systems, as specified in Table 5.3 of the DOE evaluation guidance document.

The data-gathering phase of the evaluation did result in one finding related to the use of leak path factors (LPFs) in the DSA. The LPFs chosen for two of the design/evaluation accident scenarios were qualitatively derived, based on the torturous path, through multiple barriers that the material would be required to pass before release from its processing location below ground. The technical basis is not well documented or supported by quantitative analysis such as results of engineering calculations or computer code runs, as recommended by the DOE evaluation guidance document. Also, it was found that the material at risk (MAR) assumed in one of these accidents represents an overly conservative assumption for current NWCF conditions. As a result of these findings, the unreviewed safety question process for a potentially inadequate safety analysis has been initiated to evaluate the significance of the application of an LPF less than one to the consequences of this DSA. The DSA will be revised to evaluate the unmitigated events with no credit for LPF. The revision will also update the MAR assumption and doses calculated using the DOE-recommended MELCOR Accident Consequence Code 2 (MACCS2) computer code. It is expected that the MAR and computer code changes will result in a significant reduction in the on-Site and Off-Site consequences. Documentation of the passive design features that provide the basis the LPF will be included as required to support application of the mitigative feature.

CONTENTS

ACRONYMS

ALARA	as low as reasonably achievable
CVS	Confinement Ventilation System
CWI	CH2M–WG Idaho, LLC
DBE	design basis earthquake
DBT	design basis tornado
DCS	Distributed Control System
DF	decontamination factor
DNFSB	Defense Nuclear Facilities Safety Board
DOE	Department of Energy
DOE-ID	Department of Energy, Idaho Operations Office
DSA	Documented Safety Analysis
ETS	Evaporator Tank System
HV	heating and ventilating
HEPA	high-efficiency particulate air
HVAC	heating, ventilating, and air conditioning
ICP	Idaho Cleanup Project
INL	Idaho National Laboratory
INTEC	Idaho Nuclear Technology and Engineering Center
IRP	Independent Review Panel
IWTU	Integrated Waste Treatment Unit
LPF	leak path factor
MACCS	MELCOR Accident Consequence Code System
MAR	material at risk
MSL	mean sea level
MCP	management control procedure

NA	not applicable
NPH	natural phenomena hazard
NSB	nearest site boundary
NWCF	New Waste Calcining Facility
OBE	operational basis earthquake
PBF	Power Burst Facility
PISA	potential inadequacy in the safety analysis
RCRA	Resource Conservation and Recovery Act
RH	remote-handled
RSAC	Radiological Safety Analysis Code
RSS	Rapid Shutdown System
SAR	Safety Analysis Report
SBW	sodium-bearing waste
SDD	system description document
SSC	system, structure, or component
SSE	safe shutdown earthquake
SUPS	Standby Uninterruptible Power System
TAN	Test Area North
TBP	tributyl phosphate
TEDE	total effective dose equivalent
TPR	technical procedure
TRU	transuranic
TSR	technical safety requirement
WC	water column
WIPP	Waste Isolation Pilot Plant

New Waste Calcining Facility Ventilation System Pilot Evaluation

1. INTRODUCTION

The following sections provide a facility overview of the New Waste Calcining Facility (NWCF) and an overview of the confinement ventilation system strategy.

1.1 Facility Overview

The NWCF is categorized as a Hazard Category 2 nuclear facility based on the total quantity of nuclear material that could be available for an unmitigated release. The facility began hot operations in 1982. Until June of 2002, the primary mission of the NWCF was to convert radioactive liquid waste into a granular solid called calcine and to destroy waste process solvents by using them as a combustion fuel in the calcine process. The calcination process is now closed in accordance with Resource Conservation and Recovery Act (RCRA) regulations. There are no plans to restart calcining. Now the primary missions of the NWCF are concentrating waste solutions using the Evaporator Tank System (ETS), filter leaching, and characterizing and processing remote-handled (RH) transuranic (TRU) waste for shipment to the Waste Isolation Pilot Plant (WIPP).

The NWCF building has three main levels—one above grade and two below grade—and two main areas, the decontamination area and the calciner area. Process control takes place above grade, while the evaporation of liquid waste and filter leaching takes place below grade on the second and third levels. Decontamination area activities, which include RCRA-regulated debris treatment and RH TRU characterization and processing, are conducted above grade on the first level and below grade on the second level. The closed calciner process equipment, ETS, associated process vessels, filter leaching cell, and equipment handling radioactive effluent are housed below grade on the second and third levels—in reinforced concrete cells or cubicles—to provide environmental and personnel protection (such as confinement and attenuation of radioactive fields).

1.2 Confinement Ventilation/Strategy

The following is a list of the NWCF ventilation systems:

1. Calciner area
2. Decontamination area
3. Control room
4. Office area
5. Calcium nitrate addition room
6. Switchgear room.

The use of six independent (i.e., no common ducting or components) supply and exhaust systems for general working and limited access areas minimizes the potential for cross-contamination in areas normally occupied by plant personnel (such as the control room, offices, and chemical makeup area).

Of the six separate ventilation systems at the NWCF, only the calciner area and decontamination area systems could warrant consideration as credited equipment to provide a confinement function for releases. The accident analysis for potential events in these areas relied upon passive confinement rather than crediting the active systems. The ventilation systems have been in service for approximately 24 years without undergoing significant modifications. Design information for these systems can be found in the system description document and in detailed system drawings available through the NWCF system engineer.

The heating and ventilating (HV) uses a cascading negative airflow in the NWCF that prevents contamination spread from areas of greater contamination potential to areas of lesser contamination potential. Pressure differentials are maintained in the building between different confinement zones and between the outside atmosphere to ensure that airflow is toward the zones with greater potential for contamination. The HV airflow generally moves in a once-through pattern, from filtered inlets into building areas, then into exhaust ventilation ducting, and finally to exhaust filtration and discharge.

Supply air is distributed throughout the NWCF by means of conventional sheet-steel duct systems. high-efficiency particulate air (HEPA) filters are provided wherever the supply air enters a potentially contaminated area from an operating corridor to prevent the reverse flow of contamination. Each filter has a bagout feature that allows changeout in the contaminated area while protecting the contamination area boundary. HEPA filters are installed on the main building ventilation exit streams and on all process cell and cubicle inlet air streams.

Increased exhaust flow of air occurs when the cell and cubical doors are open and during hatch removal. Devices control and indicate the pressure differentials between confinement zones. Alarms indicate when pressure differentials are outside the prescribed range.

Automatic control and monitoring of the calciner and decontamination area ventilation systems are maintained through a computerized system with operator interfaces, readouts, and alarms located in the control room. Certain aspects of the systems can be controlled manually within the rules of the automatic control system that ensure manual actions do not compromise confinement.

The calciner area and decontamination area ventilation systems operate independently of each other. The airflow from the decontamination area passes through the calciner area system scrubber for removal of corrosive vapors. The calciner area ventilation system was designed for extreme conditions including a design basis tornado, design basis seismic accelerations, temperatures associated with the calciner and ETS, in-cell and out-of-cell fires, and accidental radiological releases from calciner and ETS operations. The decontamination area ventilation system has also been designed for in-cell and out-of-cell fires and earthquakes, but is not hardened for tornados.

1.3 Major Modifications

There are no major modifications to the facility. The facility will undergo minor modifications to support treatment of the sodium-bearing waste (SBW) by the Integrated Waste Treatment Unit (IWTU) and the RH TRU projects. For the IWTU project, SBW waste will be transferred from the Tank Farm to the NWCF blend and hold tanks. The SBW will then be transferred from the blend and hold tanks to the IWTU for treatment using a steam reforming process. The facility will be modified to facilitate these transfers to the IWTU. The RH TRU project will require modifications to the NWCF to facilitate characterization and processing of RH TRU waste for shipment to WIPP. A real-time radiography system will be installed in the decontamination area and a TRU canister lag storage unit and cask stands will be installed in the crane maintenance area.

2. FUNCTIONAL CLASSIFICATION ASSESSMENT

The following sections discuss the appropriateness of the existing functional classification of the ventilation and supporting systems.

2.1 Existing Classification

The functional classifications of the NWCF ventilation systems are documented in the NWCF documented safety analysis (DSA). The current NWCF DSA is Idaho Nuclear Technology and Engineering Center (INTEC) SAR-103, "New Waste Calcining Facility," Revision 3.[1] Revision 4 to Safety Analysis Report (SAR)-103 is expected to be approved in September 2006.

None of the scenarios in the DSA classify ventilation as a safety-significant or safety-class feature required for reducing the consequences of a release. A filter degradation scenario in the NWCF DSA hazard evaluation credits ventilation and process off-gas filtration as a safety requirement for reducing radiological consequences.

2.2 Evaluation

The process used in performing the functional classification evaluation was to review the facility DSA to identify applicable release scenarios and confinement conditions assumed in determining the consequences of mitigated and unmitigated releases, and determine if ventilation is properly credited as a safety-significant or safety-class system. If ventilation is credited, the DSA would also be reviewed to identify credited system functions and required performance criteria.

The hazard analysis in the NWCF DSA evaluates credible scenarios for radiological hazards, nonradiological hazards, explosions, and natural phenomena hazards (NPHs). There are no credible criticality scenarios. The radiological hazard scenarios include HEPA filter failure, fire, explosion, direct radiation exposure, leaks, breaches, drops, and a deflagration. The nonradiological hazard scenarios include nitric acid releases due to corrosion, spills, and leaks; container leaks; and asphyxiation. Credible NPH scenarios are developed for tornado, flood, lightning, and earthquake hazards.

Bounding release scenarios considered for evaluation are listed below:

- ETS nitrated-organic reaction/deflagration
- Ventilation HEPA filter degradation by fire
- Diesel fuel fire involving RH TRU waste
- Container breach involving RH TRU waste
- RH TRU drum repackaging fire
- RH TRU drum deflagration
- Earthquake.

The following provides a basis for excluding scenario categories from consideration in the ventilation system evaluation:

1. **Nuclear Criticality.** There are no credible criticality scenarios. Tank Farm solutions processed in the ETS contain only trace amounts of uranium and are safe to concentrate through the evaporator. With the phaseout of fuel reprocessing, there are no significant sources of uranium at the INTEC that could be transferred to the Tank Farm that would increase the current uranium concentration. There are no credible criticality scenarios for RH TRU or filter leaching operations.

2. **Direct Radiation.** Confinement systems provide no safety function for direct radiation hazards.

3. **Nonradiological Hazardous Materials.** The evaluation criterion in the U.S. Department of Energy (DOE) guidance document, *Ventilation System Evaluation Guidance Document* (January 2006), focuses on the hazards of radiological materials. Similar criteria for nonradiological hazardous materials and asphyxiation hazards are not provided. Toxicity of nonradiological materials was considered within the hazard analysis documented in Chapter 3 of SAR-103. No chemical events present conditions that exceed on-Site exposure guidelines. The facility worker is also subject to high-temperature liquid and shrapnel in a deflagration of the ETS. The ventilation system will not reduce the consequences of the event. The control strategy is focused on preventing the event.

4. **Tornado.** The design and construction of the NWCF included facility and system hardening for a design basis tornado (DBT). For this reason, portions of the calciner area ventilation system are hardened against a tornado hazard and would be expected to meet the required design criteria for tornados. The decontamination area ventilation system design did not include tornado design features. DOE-STD-1020-2002, "Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities,"[2] was issued after the NWCF went into hot operations and does not include tornado design criteria for the Idaho National Laboratory (INL). The annual exceedance probability at the intersection of a site's straight wind and tornado hazard curves is used to determine if tornadoes should be a part of the site design criteria. If the exceedance probability at the intersection of the curves for a DOE site is greater than or equal to 2×10^{-5}, then tornado design criteria are specified in the standard.

5. **Lightning.** The hazard evaluation in the DSA determines that the consequences of a lightning strike on the NWCF are bounded by other fire events. The design and construction of the NWCF includes lightning protection. Lightning protection is a standard feature for nuclear facilities at the INL. While an active ventilation system may reduce the consequences of a fire event, a lightning-initiated fire would not be expected to propagate to material processing and storage areas to involve material at risk (MAR).

6. **Flooding.** The design and construction of the NWCF included facility siting, design, and construction for a design-basis flood. An active ventilation system could not be credited as a mitigative feature for a release caused by flooding.

Attachment B lists the classifications for each of the scenarios considered in the evaluation and the MARs for each of the design/evaluation-basis accidents. The format for the classification table in Attachment B is derived from Table 4.3 of the DOE ventilation system evaluation guidance document.[3]

From Attachment B it can be seen that the nitrated-organic reaction and RH TRU drum handling fire scenarios assumed leak path factors (LPFs) other than one in developing the source terms. These two scenarios and the bases for the LPFs are discussed in more detail in Attachment B.

The information in Attachment B was submitted to the DOE Independent Review Panel (IRP) on June 30, 2006. The IRPs response to the submittal is included as Attachment C.

2.3 Summary

The hazard and accident analysis in the DSA do not specify the ventilation systems as safety-significant or safety-class. Therefore, functional requirements and performance criteria are not identified for any of the NWCF ventilation systems.

The LPFs chosen for the ETS deflagration and TRU drum-handling fire scenarios were qualitatively derived and do not have a strong technical basis that includes identification and quantitative evaluation of the actual leak paths through the facility to the outside environment. Further, in the case of the nitrated-organic reaction scenario, the MAR assumed in the source term calculation is based on first-cycle rafinates from the processing of a conservative fuel type. Fuel processing is no longer performed at INTEC. These rafinates no longer exist at INTEC and represent an overly conservative MAR assumption for NWCF scenarios. Further, the conditions for the nitrated-organic reaction scenario may no longer exist.

The unreviewed safety question (USQ) process for a potential inadequacy in the safety analysis (PISA) has been initiated to evaluate the significance of the application of an LPF less than one to the consequences in the NWCF DSA. The DSA will be revised to evaluate the unmitigated events with no credit for LPF. The revision will also update the MAR assumption and doses calculated using the DOE-recommended MELCOR Accident Consequence Code Version 2 (MACCS2) computer code.[4,5] It is expected that the MAR and computer code changes will result in a significant reduction in the on-Site and off-Site consequences. Documentation of the passive design features that provide the basis the LPF will be included as required to support application of the mitigative feature.

3. SYSTEM EVALUATION

The Site Evaluation Team, the Facility Evaluation Team, and the DOE IRP agreed that the system evaluation should be performed against the attributes of a safety-significant system. These attributes are found in Table 5.1 of the DOE ventilation system evaluation guidance document.[3] All the applicable nondiscretionary attributes of a safety-significant system were considered mandatory by the Site and Facility Evaluation Teams.

As previously discussed (see Section 1.2), only the calciner and decontamination area ventilation systems could warrant consideration as credited equipment to provide a confinement function for releases. The accident analysis for potential events in these areas relied upon passive confinement rather than crediting the active systems. Therefore, the calciner and decontamination area ventilation systems are evaluated against the attributes. The impact of scenarios listed in Appendix B on the ventilation systems were considered as a part of the evaluation.

The system evaluation involved system walk-downs by the Site Evaluation Team and the Facility Evaluation Team. The NWCF ventilation system design description (SDD)[6] and facility fire hazards analysis[7] were reviewed, and the ventilation system engineer was consulted as the evaluation was being performed.

Attachment D shows the results of the calciner and decontamination area ventilation system evaluations against the criteria for safety-significant systems. The system evaluation results demonstrated that these systems meet each nondiscretionary attribute of a safety-significant system. Therefore, there are no gaps between the actual system attributes and the expected attributes of a safety-significant system.

4. CONCLUSION

Based on the results of the hazard and accident analyses, the ventilation systems for the NWCF facility are not required to be designated as safety-significant or safety-class systems. The results for two release scenarios developed in the DSA are based on LPFs other than one. Selection of the LPFs is based on a qualitative assessment of the location of the releases below ground surface rather than on a strong technical basis grounded on quantitative analyses or computer modeling.

The PISA process has been initiated to evaluate the significance of the application of an LPF less than one to the consequences in the NWCF DSA. The DSA will be revised to evaluate the unmitigated events with no credit for LPF. The revision will also update the MAR assumption and doses calculated using the DOE-recommended MACCS2 computer code.[4,5] It is expected that the MAR and computer code changes will result in a significant reduction in the on-Site and off-Site consequences. Documentation of the passive design features that provide the basis for the LPF will be included as required to support application of the mitigative feature.

Two of the six noncredited ventilation systems were evaluated against the attributes expected of safety-significant systems. Both systems meet all the attributes. Therefore, there are no gaps, and modifications to the systems are not required.

5. REFERENCES

1. SAR-103, "New Waste Calcining Facility," Rev. 3, September 6, 2005.

2. DOE-STD-1020-2002, "Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities," U.S. Department of Energy, January 2002.

3. DOE, "Deliverables 8.5.4 and 8.7 of Implementation Plan for Defense Nuclear Safety Board Recommendation 2004-2," Rev. 0, U.S. Department of Energy, January 2006.

4. D. I. Chanin (1998a), M. I. Young, and J. Randall, "Code Manual for MACCS2: Volume 1, User's Guide;" NUREG/CR-6613 (SAND97-0594), Sandia National Laboratories, published by the U.S. Nuclear Regulatory Commission, Washington, DC, 1998.

5. H-N Jow (1990), J. L. Sprung, J. A. Rollstin, L. T. Ritchie, and D. I. Chanin, "MELCOR Accident Consequence Code System (MACCS)," Volume 2 Model Description; Sandia National Laboratories, Albuquerque, NM, NUREG/CR-4691 (SAND86-1562).

6. SDD-143, "System Description, INTEC-659 Heating, Ventilation, and Air Conditioning," Rev. 0, September 2003.

7. HAD-74, "Fire Hazards Analysis for CPP-659, New Waste Calcining Facility (NWCF)," Rev. 5, March 31, 2005.

Attachment 1

Facility Evaluation Team Biographical Sketches

Patrice McEahern
Safety Basis Subject Matter Expert

Ms. McEahern is the Director of Nuclear Safety for CWI. She provides senior-level technical and strategic guidance to the nuclear safety program. Ms. McEahern is participating as a contributing author to the DOE TRU Waste Standard development team. Her experience includes providing support to many DOE sites, such Oak Ridge, Hanford, Rocky Flats, Lawrence Livermore, Los Alamos, Savannah River Site, Mound, Fernald and Brook Haven. Ms. McEahern is also working with a team for the International Atomic Energy Agency to develop an international standard for developing the decommissioning safety case. Ms. McEahern has more than 23 years of experience in the nuclear industry including experience in systems engineering, quality systems engineering and nuclear safety analysis. She has a bachelor's degree in Engineering Science from Colorado State University.

Rod Peatross
Facility Safety Basis Subject Matter Expert

Mr. Peatross is the Nuclear Safety Group Lead for the Liquid Waste Facility Closure Project (LWFCP). He is responsible for leading a group of safety analysts in providing nuclear safety support to the LWFCP facilities, including the NWCF. His group develops and maintains regulation-compliant DSAs, TSRs, and unreviewed safety question assessments, and works with facility management and Department of Energy Idaho Operations Office (DOE-ID) to resolve nuclear safety issues. Mr. Peatross has 17 years of experience in implementing, reviewing, and developing safety-basis documents for new and existing nuclear and nonnuclear facilities and activities at the INL. He has a masters of science degree in occupational safety from the University of Idaho.

Dave Heasley
NWCF Ventilation System Subject Matter Expert

Mr. Heasley is the NWCF System Engineer. He is particularly experienced in the design, history, and operation of the NWCF ventilation systems. He has been involved with the NWCF since it started hot operations in 1982 and has over 30 years experience at the INL.

Attachment 2

System Functional Classifications and Materials at Risk

1. FUNCTIONAL CLASSIFICATIONS

Table 1. Release scenarios and functional classifications from the NWCF DSA.

NWCF Facility			Hazard Category 2				Performance Expectations			
Bounding Accidents	Confinement Type		Unmitigated Bounding Doses (rem)	Confinement Classification			Function	Functional Requirements	Performance Criteria	Compensatory Measures
	Active	Passive		Safety-Class Confinement	Safety-Significant Confinement	Defense in-Depth				
ETS nitrated-organic reaction	None credited	ETS cell and Room 428 LPF = 0.01	100 m = 6 13.9 km = 0.1	None required	None required	None required or credited	NA	NA	NA	NA
HEPA filter degradation	None credited	None credited	100 m = 2E-04 200 m =0.2 13.7 km = 0.04	None required	None required	"Safety requirement" for ventilation and process off-gas filters.	NA	NA	NA	NA
Diesel fuel fire involving RH TRU	None credited	None credited	100 m = 9 13.7 km = < 0.07	None required	None required	None required or credited	NA	NA	NA	NA
Container breach involving RH TRU	None credited	None credited	100 m = 0.6 13.7 km = <5E-03	None required	None required	None required or credited	NA	NA	NA	NA
RH TRU drum repackaging fire	None credited	Spray booth or Cell 308 LPF = 0.1	100 m = 2 13.7 km = 0.02	None required	None required	None required or credited	NA	NA	NA	NA
RH TRU drum deflagration	None credited	None credited	100 m = 1 13.7 km = <0.01	None required	None required	None required or credited	NA	NA	NA	NA
Earthquake event	None credited	None credited	Qualitatively determined to be low consequences at all receptor locations.	None required	None required	None required or credited	NA	NA	NA	NA

2. MATERIALS AT RISK

Table 2. Material at risk (MAR) for nitrated-organic reaction scenario.

Nuclide	Ci
^{3}H	5.00E-01
^{60}Co	3.78E+00
^{63}Ni	6.96E-01
^{90}Sr	3.63E+03
^{90}Y	3.63E+03
^{99}Tc	2.57E-01
^{106}Ru	2.27E-01
^{106}Rh	2.88E+01
^{125}Sb	4.09E+00
^{129}I	4.09E-02
^{134}Cs	3.03E+01
^{137}Cs	3.48E+03
^{137m}Ba	3.29E+03
^{144}Ce	8.33E+01
^{154}Eu	2.12E+01
^{155}Eu	2.57E+01
^{237}Np	5.90E-02
^{238}Pu	9.84E+00
^{239}Pu	1.44E+00
^{241}Am	1.21E+00

Table 3. MAR for exhaust-filter breach.

Nuclide	Feed Activity (mCi/L)
^{60}Co	1.9E-01
^{90}Sr	2.9E+01
^{90}Y	2.9E+01
^{125}Sb	2.7E-01
^{134}Cs	1.1E+00
^{137}Cs	3.0E+01
^{137m}Ba	2.8E+01
^{154}Eu	3.8E-01
^{155}Eu	1.9E-01
^{238}Pu	6.6E-01
^{239}Pu	1.0E-01
^{241}Am	6.0E-02

MAR for Vehicle Fire Involving RH TRU. For multiple drums involved in a diesel pool fire, the MAR was assumed to be 12.4 Pu-239 eq. Ci/drum, or 148.8 Pu-239 eq. Ci in 12 drums.

MAR for Container Breach Involving RH TRU. For drums involved in a container breach accident, the MAR was assumed to be 12.4 Pu-239 eq. Ci/drum.

MAR for RH TRU Drum Repackaging Fire. For material involved in a drum repackaging fire, the MAR was assumed to be 12.4 Pu-239 eq. Ci/drum.

MAR for RH TRU Drum Deflagration. For material involved in a drum deflagration, the MAR is a waste drum with 12.4 Pu-239 eq. Ci/drum.

3. EXPLANATION OF LEAK PATH FACTORS

Two scenarios used LPFs other than one. These are the nitrated-organic reaction and the RH TRU drum loading fire scenarios. The following sections described these scenarios and discuss the derivation of the LPFs.

3.1 ETS Nitrated-Organic Reaction Scenario

In the ETS process, a nitrated-organic reaction could occur from a separate organic phase encountering concentrated nitrates under acidic conditions. A self-accelerating reaction could cause harm to workers and damage to equipment, and require extensive cleanup of the facility.

The frequency of this scenario is estimated to be unlikely. A report by the Defense Nuclear Facility Safety Board (DNFSB), sample analysis results, and operating knowledge provide the bases for the frequency. The DNFSB performed a review of potential for nitrated-organic reactions, and concluded that "The Chemical Processing Plant Facility (CPP) at Idaho National Engineering and Environmental Laboratory (INEEL) is considered capable but extremely unlikely to produce a red oil event." Current sample results show the tributyl phosphate (TBP) concentrations to be in the parts per billion (ppb) range. Fuel reprocessing activities have ceased, and no reprocessing waste exists in the Tank Farm. Most, if not all, organics would have been vaporized in the calcination process (500 to 600°C [932 to 1,112°F]) and would not have been found as residue in the dissolved bed solutions. The presence of concentrated nitrates (7 to 10 *M*) is necessary for a nitrated-organic reaction to occur. Chemicals such as nitric acid and aluminum nitrate were used extensively in fuel processing operations. Thus, Tank Farm solutions contain nitrates. The solutions that are processed through the ETS contain significant quantities of nitrates. The current nitrate molarity for the Tank Farm solutions to be processed range from 2.59 to 5.24.

The source term analysis assumed an LPF of 1% determined qualitatively, based on the location of the event and physical barriers to a release outside the facility. The physical barriers include a concrete-shielded cell below ground surface level with thick concrete and steel-shielded access hatches to the maintenance area. A release from the maintenance area to the outside environment would then be through the maintenance area super structure. The majority of the radionuclides released to the maintenance area would remain in the NWCF due to condensation or contact with walls and equipment. However, some small quantity of radionuclides is assumed to escape through unfiltered exits, such as the roll-up door, during the brief period of pressurization.

The source term analysis also determined a damage ratio of 10% based on analysis results of a red oil explosion in 1993 at the Tomsk-7 plant in Russia. The Tomsk-7 nitrated-organic reaction resulted in less than 10% of the vessel solution being released from the cell.

The source term calculation assumed a compilation of the maximum concentration of each radionuclide in the Tank Farm and an evaporator operating volume of 2,000 gal. The INL-specific RSAC code and 95% weather conditions were used to determine the radiological doses at the nearest site boundary (NSB) and co-located worker location.

Unmitigated consequence analysis results in a total effective dose equivalent (TEDE) of approximately 0.1 rem at the NSB and a TEDE of 6 rem at the co-located worker location. These doses conservatively include ingestion at the NSB which is not required per DOE-STD-3009-94. The doses do not challenge the evaluation guideline doses of 100 rem to the facility workers and 25 rem to the off-Site public. (The evaluation guidelines for the Idaho Cleanup Project [ICP] are from SAR-100, "ICP Standardized Safety Analysis Report [SAR] Chapters," approved by DOE.) If an LPF of 1 is assumed, the resulting doses will be 10 rem at the NSB and 600 rem at the co-located worker location. In this case, the evaluation guideline for the off-Site public is approached and the off-Site evaluation guideline for the co-located worker is exceeded. Deleting ingestion at the NSB would reduce the 10-rem dose to 1 rem. The co-located worker dose of 60 rem would not be affected. The DSA qualitatively determined that the nonradiological consequences would exceed evaluation guidelines for the co-located worker, but not for the off-Site public due to the distance to the NSB. The facility worker would receive a high dose and be subject to high-temperature material, high radiation, and potential pressure or shrapnel hazards.

Technical safety requirement (TSR)-level Specific Administrative Controls for the ETS temperature parameter prevents a worker fatality and prevents the event. Implementation of the temperature limit is through an automatic system that reduces the risk of a reaction by monitoring and controlling the temperature. The ETS temperature instruments required to monitor temperature and the rapid shutdown system (RSS) are safety-significant. The DSA does not identify the need for safety-class structures, systems, or components (SSCs) because the dose at the NSB does not challenge the ICP evaluation guideline.

3.2 RH TRU Drum Repackaging Fire

During drum repackaging activities in the decontamination cell or the steam spray booth, a drum of uncontained RH TRU material could be involved in a fire. Initiators for the fire are equipment failure or electrical failure within the cell or steam spray booth. This is an anticipated event.

The MAR was assumed to be 12.4 Pu-239 equivalent Ci/drum. This MAR is based on the Pu-239 maximum fissile gram equivalent loading in an RH TRU drum retrieved from the ICP Intermediate Level Transuranic Storage Facility at the INL.

The damage ratio for the uncontained material is 1.

The respirable airborne release fraction of 1.0×10^{-2} for uncontained cellulose or largely cellulose mixed waste is assumed. This is the bounding airborne release fraction and respirable fraction values used in accordance with DOE-HDBK-3010-94.

As in the ETS nitrated-organic reaction accident, the LPF for a fire involving a finite quantity of combustible material within a passive confinement barrier is 0.1. RH TRU drum repackaging is conducted within the steam spray booth or Cell 308. A fire involving one drum of combustible material is not postulated to be an intense event that would challenge the confinement barrier provided by the building structure. The Tomsk-7 nitrated-organic reaction resulted in less than 10% of the vessel solution being released from the cell. Thus, it is assumed that 10% of the drum is released to the spray booth or cell.

The resulting doses are approximately 0.02 rem TEDE at the NSB and 2 rem TEDE at the co-located worker location. These doses do not challenge the ICP evaluation guideline of 0.5 rem for anticipated releases to the off-Site public or the co-located worker evaluation guideline of 100 rem at 100 m. Increasing the LPF from 0.1 to 1 would result in a corresponding order of magnitude increase in the doses to 0.2 rem at the NSB and 20 rem at the co-located worker location.

Attachment 3

Independent Review Panel Report

The IRP had not issued the referenced letter of concurrence at the time this evaluation report was due.

Attachment 4

System Evaluation Tables

Table 1. Comparison of the NWCF calcine area ventilation system to performance criteria.

Evaluation Criteria	Criteria Explanation	Comparison to Criteria	Reference
Ventilation System - General Criteria			
Pressure differential should be maintained between zone and atmosphere.	Number of zones as credited accident analysis to control hazardous material release; demonstrate by use considering in-leakage.	The accident analysis in the DSA does not credit contamination zone pressure differentials to control hazardous material releases. However, a zoned pressure differential approach is applied in the design and operation of the ventilation systems. The criteria would be met if the ventilation system was credited by the safety basis.	SAR-103, INTEC SAR-103 New Waste Calcining Facility, Rev. 3, Rev. 4 (draft) SDD-143, System Description Document for INTEC-659 Heating, Ventilation, and Air Conditioning, Rev. 0
Materials of construction should be appropriate for normal, abnormal and accident conditions.	None.	The ventilation system is designed for high-temperature conditions for normal operating conditions in the calcine cell and evaporator cell. The system is also designed for fires in the cells and outside the cells. A vent scrubber/mist eliminator system removes corrosive vapors and mists from the air streams, the decontamination cells and cubicles, and the filter leaching cell before the air reaches the calciner exhaust system.	SDD-143, System Description Document for INTEC-659 Heating, Ventilation, and Air Conditioning, Rev. 0
Exhaust system should withstand anticipated normal, abnormal and accident system conditions and maintain confinement integrity.	As required by the accident analysis to prevent a release.	The exhaust system withstands the anticipated normal and abnormal operations. The ventilation system is identified as a "safety requirement" in the hazard evaluation for exhaust filter failure and a fire that degrades exhaust filters. The exhaust system is not credited for any other scenario in the hazard or accident analysis. The focus is on preventing the deflagration scenario rather than on preventing a release once it has happened. Therefore, the ventilation exhaust system is not credited with reducing doses after the scenario. If the calcine area ventilation exhaust system were credited in the ETS deflagration scenario, the exhaust system would have to withstand the overpressure and heat of the deflagration. There are no studies that demonstrate the system is capable of providing a credited safety function under these conditions. If the exhaust system must be credited, survivability of the system after a deflagration must also be demonstrated. The SDD states that the one of the design objectives of the calcine ventilation system was that it would maintain confinement during in-cell and out-of-cell fires. Manually activated spray nozzles provide emergency cooling and fire	SAR-103, INTEC SAR-103 New Waste Calcining Facility, Rev. 3, Rev. 4 (draft) SDD-143, System Description Document for INTEC-659 Heating, Ventilation, and Air Conditioning, Rev. 0

Table 1. (continued)

Evaluation Criteria	Criteria Explanation	Comparison to Criteria	Reference
		protection at the exhaust plenums. Exhaust plenums have moisture separators to protect the filters if the spray system should activate. The accident consequences from this scenario are well below the evaluation guidelines; therefore, filter performance during a fire is not credited by the DSA.	
Confinement ventilation systems (CVS) shall have appropriate filtration to minimize release.	Address: (1) Type of filter (e.g., HEPA, sand, sintered metal); (2) Filter sizing (flow capacity and pressure drop); (3) Decontamination factor vs. accident analysis assumptions.	The HEPA filters on the exhaust system are designed for a decontamination factor (DF) between 4×10^7 and 1×10^7. All inlet plenums are HEPA-filtered to prevent the release of activity caused by pressurization of the system. The inlet HEPA filters to the calcine area are not tested after installation; therefore, a reduced DF is assumed for these filters. The inlet HEPA filters to the calcine cells have test fixtures and are tested after installation. The filters are rated at 1,500 scfm at 1.0 in water column (WC). The accident analysis in the DSA does not make assumptions regarding dose reduction due to filtration. The system design DF is sufficiently large that if crediting a DF would be required by the accident analysis, the required DF would be no larger than the DF already designed into the system. This performance criteria would be met.	SAR-103, INTEC SAR-103 New Waste Calcining Facility, Rev. 3, Rev. 4 (draft) SDD-143, System Description Document for INTEC-659 Heating, Ventilation, and Air Conditioning, Rev. 0
Ventilation System – Instrumentation and Control			
Provide system status instrumentation and/or alarms.	Address key information to ensure system operability (e.g., system delta-P, filter pressure drop).	Performance status of the ventilation system is continuously monitored with visual and audible feedback to operators in the NWCF control room. Feedback includes pressure differentials in potentially contaminated zones, differential pressure across the exhaust HEPA filters, air flow, vane trim, hand switch status, and fan operating status. Alarms are categorized as standard and high priority. High-priority alarms include high-high and low-low alarms that initiate the rapid shutdown system. Standard alarms include high and low alarms for flow, level, pressure, pressure differential, acidity content of the scrubber, radiation, and temperature.	SDD-143, System Description Document for INTEC-659 Heating, Ventilation, and Air Conditioning, Rev. 0
Interlock supply and exhaust fans to prevent positive pressure differential.	None.	The supply and exhaust blowers are automatically controlled from the NWCF control room. Blowers can also be manually controlled from the local control panel. When the local hand switch for a given blower is placed in the off position, the blower cannot be started from the control room. Interlocks prevent operation of the supply blowers if the exhaust blowers are not operating. Shutdown of the exhaust blowers will automatically result in a shutdown of the supply blowers.	SDD-143, System Description Document for INTEC-659 Heating, Ventilation, and Air Conditioning, Rev. 0
Post accident indication of filter break-through.	Instrumentation supports post-accident planning and	Filter buildup is monitored by pressure differential instruments. A low-pressure differential instrument indicates filter damage and activates an alarm in the	SDD-143, System Description Document for

Table 1. (continued)

Evaluation Criteria	Criteria Explanation	Comparison to Criteria	Reference
	response: should be considered critical instrumentation for safety class.	control room. Radiation monitoring instrumentation in the NWCF exhaust stack activates an alarm in the NWCF control room if preset limits are reached.	INTEC-659 Heating, Ventilation, and Air Conditioning, Rev. 0
Reliability of control system to maintain confinement function under normal, abnormal and accident conditions.	Address for example impact of potential common mode failures from events that would require active confinement function.	The reliability of the control system to maintain confinement is not credited by the facility DSA for accident conditions. Compliance with applicable codes and standards ensures that an acceptable level of system reliability is achieved for normal and abnormal conditions. There are no reliability studies addressing system reliability during accident conditions discussed in the DSA. None of the accident scenarios evaluated in the DSA require active confinement for reducing doses that approach an evaluation guideline. Active confinement would be required as a part of the radiation control program for keeping doses as low as reasonably achievable (ALARA) and for contamination control. A common mode failure may be the deflagration scenario that could result in a failure of the ETS vessel (primary confinement) and a failure of the HEPA filters (secondary confinement). Which could result in an unfiltered leak outside the facility. A PISA assessment is being performed on the appropriateness of the LPF assumed for the deflagration scenario. Beyond design basis events would result in multiple failures and significant releases.	SAR-103, INTEC SAR-103 New Waste Calcining Facility, Rev. 3, Rev. 4 (draft) SDD-143, System Description Document for INTEC-659 Heating, Ventilation, and Air Conditioning, Rev. 0
Control components should fail safe.	None	Dampers, trim vanes, blowers, and other ventilation system components are designed to fail safe to ensure confinement is maintained. Major control system component failures will result in the ventilation system going to fail safe configurations.	SDD-143, System Description Document for INTEC-659 Heating, Ventilation, and Air Conditioning, Rev. 0
Resistance to Internal Events - Fire			
Confinement ventilation systems should withstand credible fire events and be available to operate and maintain confinement.	Required for new facilities; as required by the accident analysis for existing facilities (discretionary). Must address protection of filter media.	The NWCF is not a new facility. The ventilation system is identified as a "safety requirement" in the hazard evaluation for exhaust filter failure and a fire that degrades exhaust filters. It is not credited for any other scenario in the hazard or accident analysis sections. Manually activated spray nozzles provide emergency cooling and fire protection at the exhaust plenums. Exhaust plenums have moisture separators to protect the filters if the spray system should activate.	SAR-103, INTEC SAR-103 New Waste Calcining Facility, Rev. 3, Rev. 4 (draft) SDD-143, System Description Document for INTEC-659 Heating, Ventilation, and Air Conditioning, Rev. 0

Table 1. (continued)

Evaluation Criteria	Criteria Explanation	Comparison to Criteria	Reference
Confinement ventilation systems should not propagate spread of fire.	Required for new facilities; as required by the accident analysis for existing facilities (discretionary). Address fire barriers, fire dampers arrangement.	The ventilation system is identified as a "safety requirement" in the hazard evaluation for exhaust filter failure and a fire that degrades exhaust filters. The calcine area system is not credited with preventing fire propagation All NWCF ventilation systems are designed to operate independent of each other. Therefore, a fire in the calcine area could not propagate to the decontamination area through the ventilation system. Manually activated spray nozzles provide emergency cooling and fire protection at the exhaust plenums.	SAR-103, INTEC SAR-103 New Waste Calcining Facility, Rev. 3, Rev. 4 (draft)
Resistance to Internal Events – Natural Phenomena - Seismic			
Confinement ventilation systems should safely withstand earthquakes	If the active CVS system is not credited in a seismic accident condition there is no need to evaluate that performance and/or design attribute for the confinement ventilation system (discretionary). Also, any seismic impact on the confinement ventilation system performance will be based on the current functional requirement in the DSA. NOTE: Seismic requirements may apply to defense-in-depth items indirectly for the protection of safety SSCs.	The ventilation system is identified as a "safety requirement" in the hazard evaluation for exhaust filter failure and a fire that degrades exhaust filters. It is not credited in a seismic accident. The calcine area ventilation system is seismically designed. For the original NWCF design, the safe shutdown earthquake (SSE) was defined as a maximum credible INTEC earthquake of 7.75 on the Richter scale, with a resultant horizontal bedrock acceleration of 0.33 g (gravitational force) and a resultant vertical bedrock acceleration of 0.22 g. The primary design concern for the SSE was confinement of radioactivity during and following the earthquake. An operational basis earthquake (OBE) equal to one-half of the magnitude of the SSE was selected. The minimum OBE at the INTEC was an earthquake with a resultant horizontal bedrock acceleration of 0.17 g and a resultant vertical bedrock acceleration of 0.11 g. Important systems were designed to "ride through" the OBE without significant problems or unacceptable economic loss. In addition, the OBE would not destroy those features of the plant necessary for continued safe operation. If credited, the ventilation systems would safety withstand the OBE.	SAR-103, INTEC SAR-103 New Waste Calcining Facility, Rev. 1, Rev. 3, Rev. 4 (draft)
Resistance to External Events – Natural Phenomena – Tornado/Wind			
Confinement ventilation system should safely withstand tornado depressurization.	If the active CVS system is not credited in a tornado condition there is no need to evaluate that performance and/or design attribute for the confinement ventilation system (discretionary). Also,	The calcine area ventilation system is designed to a design basis tornado (DBT). The ventilation system is identified as a "safety requirement" in the hazard evaluation for exhaust filter failure and a fire that degrades exhaust filters. It is not credited in a tornado condition. DOE-STD-1020-2002 does not identify tornado criteria for the INL. However, the NWCF is designed with tornado protection features that would prevent unacceptable radiological consequences	SAR-103, INTEC SAR-103 New Waste Calcining Facility, Rev. 1, Rev. 3, Rev. 4 (draft)

Table 1. (continued)

Evaluation Criteria	Criteria Explanation	Comparison to Criteria	Reference
	any tornado impact on the confinement ventilation system performance will be based on the current functional requirement in the DSA.	if it were struck by a DBT with the following characteristics: 1. A tornado rotational wind velocity of 150 mph 2. A translational wind velocity of 25 mph 3. A radius of maximum rotational wind of 150 ft 4. A peak pressure differential of 0.75 psi from an ambient atmospheric pressure of 12.25 psi 5. A pressure transient of a decrease of 0.25 psi/s over a period of 3 sec followed by an increase back to ambient in 3 sec 6. The missiles listed below in the following table:	

DBT missiles.

Object	Dimensions	Weight (lb)	Velocity (mph)
Wood plank	4 in. × 12 in. × 12 ft	115	130
6-in. Schedule 40 pipe	6.6 in. in dia × 15 ft	289	22
1-in. steel rod	1.0 in. in dia × 4 ft	9	18
Utility pole	13.5 in. in dia × 35 ft	1,120	58
12-in. Schedule 40 pipe	12.6 in. in dia × 15 ft	750	16
Automobile	16.4 × 6.6 × 4.3 ft	4,000	92

Abovegrade areas necessary for process control, radiological confinement, and ventilation control have been hardened to DBT limits. These areas include the control room (438), the switchgear room (433), the standby generator room (432), the HV equipment room (434), operations offices (436 and 437), corridors (435 and 409), computer equipment room (439), Stairway No. 1, calciner exhaust air plenum room (423), and calciner supply air plenum room (601).

A tornado backdraft damper is installed at the calciner area system air intake.

Table 1. (continued)

Evaluation Criteria	Criteria Explanation	Comparison to Criteria	Reference
Confinement ventilation system should withstand design wind effects on system performance.	If the active CVS system is not credited in a wind condition, there is no need to evaluate that performance and/or design attribute for the confinement ventilation system (discretionary). Also, any wind impact on the confinement ventilation system performance will be abased on the current NPH analysis in the DSA.	The ventilation system is identified as a "safety requirement" in the hazard evaluation for exhaust filter failure and a fire that degrades exhaust filters. It is not credited in a wind condition. The design of the facility for tornados bounds the design for high winds.	SAR-103, INTEC SAR-103 New Waste Calcining Facility, Rev. 3, Rev. 4 (draft)
Other NP Events (e.g., flooding, precipitation)			
Confinement ventilation system should withstand other NPH events considered credible in the DSA where the confinement ventilation system is credited.	If the active CVS system is not credited for this event, there is no need to evaluate that performance and/or design attribute for the confinement ventilation system (discretionary). Also, any impact on the confinement ventilation system performance will be based on the current NPH analysis in the DSA.	The ventilation system is identified as a safety requirement in the hazard evaluation for exhaust filter failure and a fire that degrades exhaust filters. It is not credited in any natural phenomena condition. However, the NWCF is by design protected from flooding. The 10,000-yr flood crest at the NWCF is estimated to be 4,912 ft above mean sea level (MSL). The NWCF abovegrade first level is 4,917 ft above MSL or about 5 ft above the estimated flood stage level. Subsurface hydraulic pressures will be insignificant, because neither the flooding time nor the water volume will be sufficient to saturate the soil to depths of 30 to 40 ft.	SAR-103, INTEC SAR-103 New Waste Calcining Facility, Rev. 3, Rev. 4 (draft) Big Lost River Flood Report, BLM
Range Fires/Dust Storms			
Administrative controls should be established to protect confinement ventilation systems from barrier threatening events.	Ensure a properly thought out response to external threat is defined (e.g., pre-fire plan).	There are no TSR-level administrative controls that directly address protecting confinement barriers from range fires or dust storms. There are TSR-level administrative controls for establishing safety management programs, for emergency preparedness and fire protection that include nuclear safety attributes of provision for controlling combustible material loading; ensuring that prefire strategies, plans, procedures and fire hazards analyses are performed; and for maintaining approved emergency response procedures.	TSR-103, Technical Safety Requirements New Waste Calcining Facility TSR-100, INEEL Standardized Technical Safety Requirements (TSR) Document

Table 1. (continued)

Evaluation Criteria	Criteria Explanation	Comparison to Criteria	Reference
		Testability	
Design supports the periodic inspection and testing of filters and housing. Tests and inspections are conducted periodically.	Ability to test for leakage per intent of N510.	The design of the facility ventilation systems includes ports for testing the integrity and installation of inlet HEPA filters to cells and HEPA filters in the exhaust plenums. The filters are tested at least annually.	MCP-2746, Purchasing, Maintaining, and Using HEPA Filters TPR-5054, HEPA Filter In-Place Testing TPR-7153, NWCF HEPA Filter In-Place (Aerosol) Testing
Instrumentation required to support system operability is calibrated	Credited instrumentation should have specified calibration/surveillance requirements. Non-safety instrumentation should be calibrated as necessary to support system functionality.	The DSA for the NWCF does not credit ventilation system instrumentation in any accident scenario. Ventilation system instrument calibration is performed in accordance with a management control procedure (MCP).	SAR-103, INTEC SAR-103 New Waste Calcining Facility, Rev. 3, Rev. 4 (draft) MCP-1155, INTEC/TAN/PBF Calibration Program (Supplement to MCP-6303)
Integrated system performance testing is specified and performed.	Required responses assumed in the accident analysis must be periodically confirmed including any time constraints.	Preoperational tests are specified in Technical Procedure (TPR)-7121. Periodic testing of blowers is also specified in procedures. The accident analysis in the DSA does not identify required responses for the ventilation system.	SAR-103, INTEC SAR-103 New Waste Calcining Facility, Rev. 3, Rev. 4 (draft) TPR-7121, Calciner Area HVAC Startup and Shutdown TPR-7125 NWCF HVAC Normal Operations

Table 1. (continued)

Evaluation Criteria	Criteria Explanation	Comparison to Criteria	Reference
Maintenance			
Filter service life program should be established.	Filter life (shelf life, service life, total life) expectancy should be determined. Consider filter environment, maximum delta-P, radiological loading, age, and potential chemical exposure.	Instructions for replacing, operating, and in-place (aerosol testing) NWCF filter components are specified in procedure. Filters are replaced if inplace testing indicates filter damage or leakage.	TPR-7146, Replace Off-Gas Filter Components TPR-5054, HEPA Filter In-Place Testing TPR-7153, NWCF HEPA Filter In-Place (Aerosol) Testing
Single Failure			
Failure of one component (equipment or control) shall not affect continuous operation.	Criteria does not apply to safety-significant systems.	Not applicable.	Not applicable
Automatic backup electrical power shall be provided to all critical instruments and equipment required to operate and monitor the confinement ventilation system.	Criteria does not apply to safety-significant systems.	Not applicable.	Not applicable
Backup electrical power shall be provided to all critical instruments and equipment required to operate and monitor the confinement ventilation system.	None.	Power to the Distributed Control System that monitors and controls the ventilation system is backed by a standby uninterruptible power supply (SUPS). The SUPS can provide backup power for at least 20 minutes from storage batteries. The SUPS can be powered or recharged from the standby generator. The ventilation system is connected to the INTEC standby diesel generator system. The system is programmed to determine the number of generators that start during a commercial power outage and the associated loads. There is an INTEC-wide computerized hierarchy of loads that will then be added and removed, as necessary, from the standby diesel generators. The NWCF standby power is provided when the second diesel generator starts.	SAR-103, INTEC SAR-103 New Waste Calcining Facility, Rev. 3, Rev. 4 (draft).
Other Credited Functional Requirements			
Address any specific functional requirements for the confinement ventilation system (beyond the scope of those above) credited in the DSA.	None.	None.	Not applicable

Table 2. Comparison of the NWCF decontamination area ventilation system to performance criteria.

Evaluation Criteria	Criteria Explanation	Comparison to Criteria	Reference
General Criteria			
Pressure differential should be maintained between zone and atmosphere.	Number of zones as credited accident analysis to control hazardous material release; demonstrate by use considering in leakage.	The accident analysis in the DSA does not credit contamination zone pressure differentials to control hazardous material releases. However, a zoned pressure differential approach is applied in the design and operation of the ventilation system. The criteria would be met if the ventilation systems were credited by the safety basis.	SAR-103, INTEC SAR-103 New Waste Calcining Facility, Rev. 3, Rev .4 (draft) SDD-143, System Description Document for INTEC-659 Heating, Ventilation, and Air Conditioning, Rev. 0
Materials of construction should be appropriate for normal, abnormal and accident conditions.	None.	A vent scrubber/mist eliminator system in the calcine area ventilation system removes corrosive vapors and mists from the air streams from the decontamination cells and cubicles and from the filter leaching cell before the air reaches the exhaust system.	SDD-143, System Description Document for INTEC-659 Heating, Ventilation, and Air Conditioning, Rev. 0
Exhaust system should withstand anticipated normal, abnormal and accident system conditions and maintain confinement integrity.	As required by the accident analysis to prevent a release.	The decontamination area exhaust system withstands the anticipated normal and abnormal operations. The exhaust system is not credited for any scenario in the hazard or accident analysis. Manually activated spray nozzles provide emergency cooling and fire protection at the exhaust plenums. Exhaust plenums have moisture separators to protect the filters if the spray system should activate. If the decontamination area system were credited for the vehicle fire involving RH-TRU, RH-TRU drum repackaging fire, and RH-TRU drum deflagration; the exhaust system would have to withstand the overpressure of the deflagration scenario and the heat of the fire scenarios while still providing the credited safety function. The system is designed for in-cell and out of cell fires. However, design of the system did not consider the impacts of drum deflagration on system function. Manually activated spray nozzles provide emergency cooling and fire protection at the exhaust plenums. Exhaust plenums have moisture separators to protect the filters if the spray system should activate.	SAR-103, INTEC SAR-103 New Waste Calcining Facility, Rev. 3, Rev. 4 (draft) SDD-143, System Description Document for INTEC-659 Heating, Ventilation, and Air Conditioning, Rev. 0

Table 2. (continued)

Evaluation Criteria	Criteria Explanation	Comparison to Criteria	Reference
Confinement ventilation systems shall have appropriate filtration to minimize release.	Address: (1) Type of filter (e.g., HEPA, sand, sintered metal); (2) Filter sizing (flow capacity and pressure drop); (3) Decontamination factor vs. accident analysis assumptions.	The HEPA filters on the exhaust system are designed for a decontamination factor (DF) between 4×10^7 and 1×10^7. The inlet plenums to the decontamination area have roughing filters and are not HEPA-filtered. Inlets to the decontamination area cells are HEPA-filtered, and are designed with test fixtures for periodic in-service testing. The accident analysis in the DSA does not make assumptions regarding dose reduction due to filtration. The system design DF is sufficiently large that if crediting a DF would be required by the accident analysis, the required DF would be no larger than the DF already designed into the system. This performance criteria would be met.	SAR-103, INTEC SAR-103 New Waste Calcining Facility, Rev. 3, Rev. 4 (draft) SDD-143, System Description Document for INTEC-659 Heating, Ventilation, and Air Conditioning, Rev. 0
Ventilation System – Instrumentation and Control			
Provide system status instrumentation and/or alarms.	Address key information to ensure system operability (e.g., system delta-P, filter pressure drop).	Performance status of the ventilation system is continuously monitored with visual and audible feedback to operators in the NWCF control room. Feedback includes pressure differentials in potentially contaminated zones, differential pressure across the exhaust HEPA filters, air flow, vane trim, hand switch status, and fan operating status. Alarms are categorized as standard and high priority. High priority alarms include high-high and low-low alarms that initiate the rapid shutdown system. Standard alarms include high and low alarms for flow, level, pressure, pressure differential, radiation, and temperature.	SDD-143, System Description Document for INTEC-659 Heating, Ventilation, and Air Conditioning, Rev. 0
Interlock supply and exhaust fans to prevent positive pressure differential.	None.	The supply and exhaust blowers are automatically controlled from the NWCF control room. Blowers can also be manually controlled from the local control panel. When the local hand switch for a given blower is placed in the off position, the blower cannot be started from the control room. Interlocks prevent operation of the supply blowers if the exhaust blowers are not operating. Shutdown of the exhaust blowers will automatically result in a shutdown of the supply blowers.	SDD-143, System Description Document for INTEC-659 Heating, Ventilation, and Air Conditioning, Rev. 0
Post accident indication of filter break-through.	Instrumentation supports post-accident planning and response: should be considered critical instrumentation for safety class.	Filter buildup is monitored by pressure differential instruments. A low-pressure differential instrument indicates filter damage and activates an alarm in the control room. Radiation monitoring instrumentation in the NWCF exhaust stack activates an alarm in the NWCF control room if preset limits are reached.	SDD-143, System Description Document for INTEC-659 Heating, Ventilation, and Air Conditioning, Rev. 0

Table 2. (continued)

Evaluation Criteria	Criteria Explanation	Comparison to Criteria	Reference
Reliability of control system to maintain confinement function under normal, abnormal and accident conditions.	Address for example impact of potential common mode failures from events that would require active confinement function.	The reliability of the control system to maintain confinement is not credited by the facility DSA. Compliance with applicable codes and standards ensures that an acceptable level of system reliability is achieved for normal and abnormal conditions. There are no reliability studies addressing system reliability during accident conditions discussed in the DSA. None of the accident scenarios evaluated in the DSA require active confinement for reducing doses that approach an evaluation guideline. Active confinement would be required as a part of the radiation control program for keeping doses ALARA and for contamination control. There are no common mode failures other than beyond design basis events that would affect the active ventilation system performance.	SAR-103, INTEC SAR-103 New Waste Calcining Facility, Rev. 3, Rev. 4 (draft) SDD-143, System Description Document for INTEC-659 Heating, Ventilation, and Air Conditioning, Rev. 0
Control components should fail safe.	None.	Dampers, trim vanes, blowers, and other ventilation system components are designed to fail safe to ensure confinement is maintained. Major control system component failures will result in the ventilation system going to fail safe configurations.	SDD-143, System Description Document for INTEC-659 Heating, Ventilation, and Air Conditioning, Rev. 0
Resistance to Internal Events - Fire			
Confinement ventilation systems should withstand credible fire events and be available to operate and maintain confinement.	Required for new facilities; as required by the accident analysis for existing facilities (discretionary). Must address protection of filter media.	The NWCF is not a new facility. The ventilation system is not credited for any scenario in the hazard or accident analysis sections. Manually activated spray nozzles provide emergency cooling and fire protection at the exhaust plenums. Exhaust plenums have moisture separators to protect the filters if the spray system should activate.	SAR-103, INTEC SAR-103 New Waste Calcining Facility, Rev. 3, Rev. 4 (draft) SDD-143, System Description Document for INTEC-659 Heating, Ventilation, and Air Conditioning, Rev. 0
Confinement ventilation systems should not propagate spread of fire.	Required for new facilities; as required by the accident analysis for existing facilities (discretionary). Address fire barriers, fire dampers arrangement.	The ventilation system is not credited with preventing fire propagation. All NWCF ventilation systems are designed to operate independently. Therefore, a fire in the calcine area could not propagate to the decontamination area through the ventilation system. Manually activated spray nozzles provide emergency cooling and fire protection at the exhaust plenums.	SAR-103, INTEC SAR-103 New Waste Calcining Facility, Rev. 3, Rev. 4 (draft)

Table 2. (continued)

Evaluation Criteria	Criteria Explanation	Comparison to Criteria	Reference
Resistance to Internal Events – Natural Phenomena - Seismic			
Confinement ventilation systems should safely withstand earthquakes.	If the active CVS system is not credited in a seismic accident condition there is no need to evaluate that performance and/or design attribute for the confinement ventilation system (discretionary). Also, any seismic impact on the confinement ventilation system performance will be based on the current functional requirement in the DSA. NOTE: Seismic requirements may apply to defense in-depth items indirectly for the protection of safety SSCs.	The NWCF DSA does not credit the ventilation system with operation during and after a DBE. The decontamination area ventilation system is not designed to the NWCF DBE.	SAR-103, INTEC SAR-103 New Waste Calcining Facility, Rev. 3, Rev. 4 (draft) SDD-143, System Description Document for INTEC-659 Heating, Ventilation, and Air Conditioning, Rev. 0
Resistance to External Events – Natural Phenomena – Tornado/Wind			
Confinement ventilation system should safely withstand tornado depressurization.	If the active CVS system is not credited in a tornado condition there is no need to evaluate that performance and/or design attribute for the confinement ventilation system (discretionary). Also, any tornado impact on the confinement ventilation system performance will be abased on the current functional requirement in the DSA.	It is not credited in a tornado condition. DOE Standard DOE-STD-1020-2002 does not identify tornado criteria for the INL. The decontamination area ventilation system is not designed to a design basis tornado (DBT).	SAR-103, INTEC SAR-103 New Waste Calcining Facility, Rev. 3, Rev. 4 (draft) DOE-STD-1020-2002

Table 2. (continued)

Evaluation Criteria	Criteria Explanation	Comparison to Criteria	Reference
Confinement ventilation system should withstand design wind effects on system performance.	If the active CVS system is not credited in a wind condition there is no need to evaluate that performance and/or design attribute for the confinement ventilation system (discretionary). Also, any wind impact on the confinement ventilation system performance will be abased on the current NPH analysis in the DSA.	The ventilation system is not credited in a wind condition.	SAR-103, INTEC SAR-103 New Waste Calcining Facility, Rev. 3, Rev. 4 (draft)
Other NP Events (e.g., flooding, precipitation)			
Confinement ventilation system should withstand other NPH events considered credible in the DSA where the confinement ventilation system is credited.	If the active CVS system is not credited for this event there is no need to evaluate that performance and/or design attribute for the confinement ventilation system (discretionary). Also, any impact on the confinement ventilation system performance will be based on the current NPH analysis in the DSA.	The ventilation system is not credited in any natural phenomena condition. However, the NWCF is protected from flooding by design. The 10,000-yr flood crest at the NWCF is estimated to be 4,912 ft above MSL. The NWCF abovegrade first level is 4,917 ft above MSL or about 5 ft above the estimated flood stage level. Subsurface hydraulic pressures will be insignificant, because neither the flooding time nor the water volume will be sufficient to saturate the soil to depths of 30 to 40 ft.	SAR-103, INTEC SAR-103 New Waste Calcining Facility, Rev. 3, Rev. 4 (draft) Big Lost River Flood Report, Bureau of Land Management
Range Fires/Dust Storms			
Administrative controls should be established to protect confinement ventilation systems from barrier threatening events.	Ensure a properly thought out response to external threat is defined (e.g., pre-fire plan).	There are no TSR-level administrative controls that directly address protecting confinement barriers from range fires or dust storms. There are TSR-level administrative controls for establishing safety management programs for emergency preparedness and fire protection that include nuclear safety attributes of provision for controlling combustible material loading; ensuring that prefire strategies, plans, procedures and fire hazards analyses are performed; and for maintaining approved emergency response procedures.	TSR-103, Technical Safety Requirements New Waste Calcining Facility TSR-100, INEEL Standardized Technical Safety Requirements (TSR) Document

Table 2. (continued)

Evaluation Criteria	Criteria Explanation	Comparison to Criteria	Reference
Testability			
Design supports the periodic inspection and testing of filters and housing. Tests and inspections are conducted periodically.	Ability to test for leakage per intent of N510.	The design of the facility ventilation systems includes ports for testing the integrity and installation of inlet HEPA filters to cells and HEPA filters in the exhaust plenums. The filters are tested at least annually.	MCP-2746, Purchasing, Maintaining, and Using HEPA Filters TPR-5054, HEPA Filter In-Place Testing TPR-7153, NWCF HEPA Filter In-Place (Aerosol) Testing
Instrumentation required to support system operability is calibrated.	Credited instrumentation should have specified calibration/surveillance requirements. Non-safety instrumentation should be calibrated as necessary to support system functionality.	The DSA for the NWCF does not credit ventilation system instrumentation in any accident scenario. Ventilation system instrument calibration is performed in accordance with MCP-1155, INTEC/TAN/PBF Calibration Program.	SAR-103, INTEC SAR-103 New Waste Calcining Facility, Rev. 3, Rev. 4 (draft) MCP-1155, INTEC/TAN/PBF Calibration Program (Supplement to MCP-6303)
Integrated system performance testing is specified and performed.	Required responses assumed in the accident analysis must be periodically confirmed, including any time constraints.	Preoperational tests for the ventilation systems are specified in procedure TPR-7122. Periodic testing of blowers is also specified in procedures. The accident analysis in the DSA does not identify required responses for the ventilation system.	SAR-103, INTEC SAR-103 New Waste Calcining Facility, Rev. 3, Rev .4 (draft) TPR-7122, Decon Area HVAC Startup and Shutdown TPR-7125 NWCF HVAC Normal Operations

Table 2. (continued)

Evaluation Criteria	Criteria Explanation	Comparison to Criteria	Reference
Maintenance			
Filter service life program should be established.	Filter life (shelf life, service life, total life) expectancy should be determined. Consider filter environment, maximum delta-P, radiological loading, age, and potential chemical exposure.	Instructions for replacing, operating, and in-place (aerosol testing) NWCF Filter components are specified in procedure. Filters are replaced if inplace testing indicates filter damage or leakage.	TPR-7146, Replace Off-Gas Filter Components TPR-5054, HEPA Filter In-Place Testing TPR-7153, NWCF HEPA Filter In-Place (Aerosol) Testing
Single Failure			
Failure of one component (equipment or control) shall not affect continuous operation.	Criteria does not apply to safety-significant systems.	Not applicable.	Not applicable
Automatic backup electrical power shall be provided to all critical instruments and equipment required to operate and monitor the confinement ventilation system.	Criteria does not apply to safety-significant systems.	Not applicable.	Not applicable
Backup electrical power shall be provided to all critical instruments and equipment required to operate and monitor the confinement ventilation system.	None.	Power to the Distributed Control System that monitors and controls the ventilation system is backed by an SUPS. The SUPS can provide backup power for at least 20 minutes from storage batteries, and can be powered or recharged from the standby generator. The ventilation system is connected to the INTEC standby diesel generator system. The system is programmed to determine the number of generators that start during a commercial power outage and the associated loads. There is an INTEC-wide computerized hierarchy of loads that will then be added and removed, as necessary, from the standby diesel generators. The NWCF standby power is provided when the second diesel generator starts.	SAR-103, INTEC SAR-103 New Waste Calcining Facility, Rev. 3, Rev. 4 (draft)
Other Credited Functional Requirements			
Address any specific functional requirements for the confinement ventilation system (beyond the scope of those above) credited in the DSA.	None.	None.	Not applicable

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RECORD NOTES:

1. This memorandum was written to transmit the Idaho Cleanup Project New Waste Calcining Facility Ventilation System Pilot Evaluation to Deputy Assistant Secretary for Safety Management and Operations. The evaluation was a joint DOE-ID and CWI effort. The DOE-ID Ventilation System SME (K. Whitham) and DOE-ID Safety Basis SME (C. Enos) participated in the NWCF ventilation systems physical inspections and the comparison of the system using safety class criteria. The final report was written by CWI, with review and input from DOE-ID and an exterior review by the DOE 2004-2 Independent Review Panel. The reviews and inspections were performed by C. Enos, however A. Preece is the Safety Basis SME for the NWCF Facility.

2. K. Whitham wrote this memo and review by C. Enos.

3. This letter/memo closes Pegasus number N/A

4. The attached correspondence has no relation to the Naval Nuclear Propulsion Program.

K. Whitham OS/QSD K. Whitham, 6-4151, September 6, 2006, O:\DOE-ID\Op Support\Quality & Safety\Operational Safety Division - General\Correspondence\2006 letters\OS-QSD-06-112-ICP Pilot final report for 2004-krw.doc