United States Government **Department of Energy**

memorandum

Idaho Operations Office

Date: August 8, 2007

Subject: Transmittal of the Idaho Nuclear Technology and Engineering Center Fuel Storage Area Ventilation System Evaluation and Irradiated Fuel Storage Facility Ventilation System Evaluation to Deputy Assistant Secretary for Safety Management and Operations (OS-QSD-07-101)

To: Dae Y. Chung, Deputy Assistant Secretary for Safety Management and Operations
DOE-HQ, EM-60/FORS

Reference: (1) Memo, I. Triay to Distribution, Subject: Revised Office of Environmental Management Expectations for Implementation of Commitment 8.6 under the Defense Nuclear Facilities Safety Board (DNFSB) 2004-2 Implementation Plan, dated March 30, 2007

(2) Report, Implementation Plan for Defense Nuclear Facilities Safety Board Recommendation 2004-2 – Active Confinement Systems, Revision 1, dated June 2006

Attached are the final evaluation reports for the Idaho Nuclear Technology and Engineering Center (INTEC) Fuel Storage Area Ventilation System Evaluation and Irradiated Fuel Storage Facility Ventilation System Evaluation. The two attachments are part of the revised milestones identified in Reference 1 to show completion of the evaluations required by the DOE 2004-2 implementation plan.

If you have questions or comments regarding this transmittal, please contact Ken Whitham 208-526-4151 or Roger Harshbarger 208-526-0568.

Richard B. Provencher, Deputy Manager
Idaho Cleanup Project

Attachments (2)

Idaho Cleanup Project

INTEC Fuel Storage Area (CPP-666) Ventilation System Evaluation

July 2007

Idaho Cleanup Project

INTEC Fuel Storage Area (CPP-666) Ventilation System Evaluation

July 2007

REVIEWS AND APPROVALS

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EXECUTIVE SUMMARY

The 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).

The evaluation for the Idaho Nuclear Technology and Engineering Center (INTEC) Fuel Storage Area 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 in December 2006. Phase II involved a ventilation system evaluation using DOE guidance document Table 5.1 and associated evaluation criteria and was submitted to the IRP for review in May 2007. Phase III involved completion of the final evaluation report and submittal to the IRP.

The INTEC Fuel Storage Area (CPP-666) is Hazard Category 2 and is designed with a combination of passive structures and a ventilation system for contamination control and worker protection. The documented safety analysis (DSA) does not require that the ventilation system be safety-significant or safety-class system, structure, or component (SSC). Therefore, functional requirements and performance criteria are not identified for the confinement ventilation system.

Per the evaluation guidance for Hazard Category 2 facilities, the performance criteria for safety-significant ventilation systems are used to evaluate the ventilation system. The result of the evaluation is that the design features of the facility ventilation system meets the nondiscretionary performance criteria for safety-significant ventilation systems, as specified in Table 5.3 of the DOE evaluation guidance document. See Section 3 for more information.

CONTENTS

ACRONYMS

CAM	continuous air monitor
CVS	confinement ventilation system
DBE	design basis earthquake
DBT	design basis tornado
DNFSB	Defense Nuclear Facilities Safety Board
DOE	Department of Energy
DOP	detailed operating procedures
DSA	Documented Safety Analysis
FAST	Fluorinel Dissolution Process and Fuel Storage
FSA	Fuel Storage Area
FDPA	Fluorinel Dissolution Process Area
HEPA	high-efficiency particulate air
HVAC	heating, ventilating, and air conditioning
INL	Idaho National Laboratory
INTEC	Idaho Nuclear Technology and Engineering Center
IRP	Independent Review Panel
LPF	leak path factor
MACCS2	MELCOR Accident Consequence Code System 2
NPH	natural phenomena hazards
OBE	operating basis earthquake
PC	performance criteria
RAM	remote air monitor
RSAC	Radiological Safety Analysis Computer
SAR	Safety Analysis Report
SC	safety class

SMCC	standby motor control center
SS	safety significant
SSC	system, structure, or component
TEDE	total effective dose equivalent
UBC	Uniform Building Code

INTEC Fuel Storage Area Ventilation System Evaluation

1. INTRODUCTION

The following sections provide a facility overview of the Idaho Nuclear Technology and Engineering Center (INTEC) Fuel Storage Area (FSA) and an overview of the confinement ventilation system strategy.

1.1 Facility Overview

The FSA began operations in April 1984, and has a specified design life of 40 years. The original mission of the FSA was to provide short-term underwater storage of fuels destined to be reprocessed in the Fluorinel Dissolution Process Area (FDPA). When the decision to end fuel reprocessing was made in April 1992, the mission of the FSA changed to receiving and storing nuclear fuel for an undefined interim period. Fuel receipt and storage at the FSA is continuing until a decision is made regarding the ultimate disposition of the fuel or until alternative fuel storage options, such as dry storage, are selected, and implemented. In accordance with a settlement agreement with the State of Idaho, the U.S. Department of Energy (DOE), and the U.S. Navy, all fuel must be removed from the FSA pools by December 31, 2023.

FSA functions include receiving fuel-loaded casks,[a] unloading fuel from these casks, preparing fuel for storage, transferring fuel to storage, storing fuel under water in fuel storage pools, retrieving fuel from storage, and loading fuel into casks.

FSA functional areas include the (1) truck receiving area; (2) cask receiving and decontamination area; (3) unloading area (including unloading and isolation pools); (4) storage pool area; (5) cutting pool area; (6) transfer channel; (7) water treatment area; (8) transfer channel extension; (9) main control room (now used as the shift operating base); (10) support areas, such as heating, ventilating, and air conditioning (HVAC); (11) office areas and other miscellaneous support areas consisting of storage rooms, rest rooms, change rooms, and showers; and (12) transfer channel ramp to the FDPA.

The primary FSA operations and/or operating systems include truck and cask receiving; fuel handling; fuel cutting (not performed in the past and not currently intended to be performed in the future) and preparation; water treatment and management; HVAC; and waste management. Truck and cask receiving operations occur in the truck receiving and the cask receiving and decontamination areas. These receipt operations include receiving cask shipments, decontaminating and venting casks, and transporting casks to different locations within and between the cask receiving and decontamination area and the fuel unloading pools.

Fuel handling operations consist of cask loading and unloading as well as fuel inspection (including ultrasonic testing), repackaging, transfer, and storage. In addition, the facility is designed for testing and canning fuel, although these operations have not occurred in the past. The fuel handling operations take place in the unloading and isolation pools, the transfer channel, the transfer channel extension, and fuel storage pools.

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a. As used here, the term "cask" includes casks, chargers, and containers used to transport irradiated fuel.

1.2 Confinement Ventilation/Strategy

At the FSA, two or more barriers are generally present to limit potential releases of radioactive material. The FSA includes the following design features or systems for confinement of radioactive materials:

- **Fuel cladding and/or fuel can** — The design philosophy for the FSA was that the fuel cladding would provide the principal confinement barrier to the release of fission products and the facility design would preclude a massive failure of the cladding of the fuel stored in the pools. Fuels with cladding defects sufficient to produce undesirable pool conditions may be canned to provide an equivalent level of protection, as described in Safety Analysis Report (SAR)-113,[1] Section 2.5.2.5.

- **Shipping casks** — The fuel shipping casks are designed to provide shielding and, in some cases, containment or confinement of gases, liquids, or solids. Casks approved for use at the FSA are listed in SAR-113, Chapter 4 or LST-335[2].

- **Basin water** — The water in the FSA (unloading pools, isolation pools, transfer channel, storage pools, and cutting pool) provides radiation shielding for normal fuel handling operations. For postulated accident conditions, the water also reduces radioactive material releases (via water-to-air release fractions).

- **Building ventilation system** — Building ventilation is designed to maintain pressure within the FSA below atmospheric pressure to ensure that building exhaust is directed through the final high-efficiency particulate air (HEPA) filtration system. Pressures are progressively lower from clean areas such as offices, to potentially contaminated and likely contaminated areas, to direct airflow accordingly. Backflow dampers prevent air from flowing in unintended directions. The backflow dampers also prevent release of unfiltered air during a transient pressure imbalance between the building and the environment. Supply air HEPA filters in the water treatment area and the FDPA filter air that could conceivably flow backward through the inlet ducts prior to release into clean areas. Barriers, airlocks, and seals are used to control undesirable airflow paths between areas via passageways and wall penetrations. Process and facility confinement barriers are reinforced by systems that detect leakage and provide alarms (remote area monitors [RAMs] and continuous air monitors [CAMs]) if airborne contamination is detected. Additional details concerning the HVAC system are available in SAR-113, Section 2.5.6.

- **Fluorinel Dissolution Process and Fuel Storage (FAST) building** — The physical structure of CPP-666 provides the final confinement barrier between the FSA and the environment. The FAST building is designed to withstand a design basis tornado (DBT) and a design basis earthquake (DBE), and maintain integrity during postulated design basis events for the FSA, as described in SAR-113, Section 2.4.2.

1.2.1 CPP-666 Fuel Storage Area Ventilation System

Ventilation air that enters the FSA, except for the small amount introduced through personnel and vehicle entries, is filtered at a common inlet and distributed throughout the building. Once-through ventilation air is directed from contamination-free areas to potentially contaminated areas, to likely contaminated areas. The ventilation system maintains the building at a slightly negative pressure, and ventilation air is discharged through a final filtration system. The design air supply to the building is approximately 84,600 ft^3/min. Normal infiltration plus compressed gas usage adds approximately 6,100 ft^3/min, resulting in a total of approximately 90,700 ft^3/min of gas processed through the final HEPA filter system for release through the 50-m (164-ft) stack (CPP-767).

Air enters the ventilation supply system through louvers. A set of roughing filters precedes two parallel fans, each capable of providing half the design air supply. The supply fans are equipped with variable-pitch inlet vanes that automatically maintain the supply air pressure. A backflow damper downstream of each fan is interlocked with the supply fans and closes when the fan is de-energized. The air supply system also includes the heating system (steam and two heat recovery systems) and evaporative cooling-air washing units. These air washers are an in-line system and air passes through them. The water supply to these systems has been isolated.

An interlock ensures that the inlet supply fans do not operate if the supply inlet damper closes or if one of the two operating final exhaust fans shuts down. The supply fans also cease operating on loss of normal power. In order for the supply fans to be started, the following three conditions must be met: (1) the supply damper must be open, (2) two of the three final exhaust fans must be operating, and (3) normal power must be available.

The exhaust system design includes two or three parallel trains of prefilters, HEPA filters, and fans to exhaust FDPA dissolver process off-gas, the FDPA dissolution cell, the fuel cutting pool area, and the water treatment area prior to mixing the exhaust with the building ventilation air in the common duct to the final HEPA filter system. The FDPA dissolver process off-gas system is isolated, since the FDPA is inactive. The fuel cutting pool area exhaust filters are also isolated. The fuel cutting pool area is exhausted via a pipe trench that connects the cutting pool area to the fuel storage pool area. Air leaving the facility is directed to a common duct for routing through the final HEPA filter system before release to the atmosphere. Exhaust air passes through an in-line fire protection chamber (currently inactive) and divides into four parallel filter banks. Each bank is designed to handle 25% of the total airflow and consists of medium-efficiency prefilters, followed by HEPA filters. The system is equipped with instrumentation to measure the pressure drop across the filters. A water spray deluge system exists, but has been made permanently inactive because the FDPA has been shut down and the threat of a hydrogen fire no longer exists. Manually operated, positive-shutoff dampers can isolate each filter bank from the exhaust airflow. Following the filters and a heat recovery coil in each duct, the air passes through a common duct to the exhaust fans.

Three exhaust fans, each sized for half the total flow (45,350 scfm), exhaust the air from the building through an underground tunnel to the exhaust stack. Each fan has variable-pitch inlet vanes automatically controlled by pressure sensors upstream of the final filters. Each fan is isolated by pneumatically operated dampers that automatically close when the fan is not operating. An exhaust relief system vents air to the atmosphere ahead of the exhaust tunnel in the event of excessive discharge pressure. The rooftop vent is located in the northwest corner of the FAST support area.

The fan motors, variable-pitch fan intake vanes, isolation dampers, and stack bypass relief are automatically activated and interlocked. Alarms sound if pressure differentials exceed either high or low settings or if airflow drops below the operating limit setting. The final exhaust fans also shut down if there is low flow, and they cannot restart until they are manually reset. Power to the exhaust fan motors is supplied from the standby motor control centers (SMCC). During the period between loss of normal power and load pick up by standby power, the exhaust fans cease operating and the isolation dampers close. Exhaust fans restart when power becomes available. If one of the two operating fans fails to start or fails after starting, the standby fan starts automatically.

The FAST heating and ventilation system is designed to withstand the operating basis earthquake (OBE) or, in the case of FDPA cell ventilation, the DBE, without loss of capability for performing its function. The stack is designed in accordance with Uniform Building Code (UBC) recommendations for Seismic Zone 3. The original design criteria were the DBE had a horizontal bedrock acceleration of 0.24 g and a vertical bedrock acceleration of 0.16 g; the OBE had a horizontal bedrock acceleration of 0.12 g and a vertical bedrock acceleration of 0.08 g. Based on a comparison between the original facility design criteria and the current criteria, the FSA design meets those for a Performance Category (PC) -3 facility.

Airflow is maintained in the specified direction by appropriate ducting of supply and exhaust air to and from each area and by controlling the area pressure. The pressure is maintained by varying the supply air to an area and keeping the exhaust flow constant. Area pressures are referenced to the basin area because of the large volume of stable air present in that area.

Pressure differential and flow control instruments at principal supply and exhaust points within the system send alarm signals to the main control room and local control panels if set limits are exceeded. Pressure and flow measurements are indicated at the main control room as well as locally within the system. Key functions of the air supply and exhaust system are controllable from the main control room.

Ventilation exhaust filters are designed for ease of change out and for bag out of the used filters to control contamination. The HEPA filters have a minimum efficiency of 99.97% tested (DOP) in accordance with MIL-STD-282. In-place filter leak-testing provisions are incorporated in the design. Radiation monitors detect changes in radioactivity buildup on filters and alarm when set points are exceeded. Local readout instrumentation for pressure drop across the filters indicates changes in filter dust loadings. A stack monitoring system is in place to sample a known representative fraction of the air leaving the facility.

During abnormal or accident conditions, negative pressure within the building as well as directed airflow through ventilation filters can be maintained at less than 50% of design flow rates with supply dampers closed and only one exhaust fan operating. Throttling of dampers in selected areas can further reduce the airflow requirements during abnormal or accident conditions. Building ventilation parameters can also be adjusted, or the system can be shut off, as needed, to support operations, maintenance, or other considerations. This flexibility is possible since system operation is not required for safety purposes, as shown by the hazard evaluation in SAR-113, Chapter 3.

1.3 Major Modifications

The CPP-666 ventilation systems are not being modified.

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 classification of the ventilation system is documented in the DSA.[1] None of the scenarios in the DSA classify the confinement ventilation system as a safety-significant (SS) or safety-class (SC) structure, system, or component (SSC) required for reducing the consequences of a release.

2.2 Evaluation

The process used in performing the functional classification evaluation was to review the 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 facility DSA evaluates credible scenarios for releases due to fire, breach of confinement, criticality, explosion, external events, and natural phenomena hazards (NPHs).

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

1. Nuclear Criticality. Ventilation provides no safety function for credible criticality scenarios. Therefore, releases from a criticality scenario are excluded from the evaluation.

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

3. Tornado. Potential releases from a tornado are excluded from Phase II evaluation. DOE-STD-1020-92, "Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities,"[3] specifically exclude Idaho National Laboratory (INL) facility evaluation and design for tornado hazards.

4. Lightning. Design and construction includes lightning protection. Lightning protection is a standard feature for all nuclear facilities at the INL.

5. Flooding. An active ventilation system could not be credited as a mitigative feature for a release caused by flooding.

Attachment 2 lists the classifications for each of the scenarios considered in the evaluation. The format for the classification table in Attachment 2 is derived from Table 4.3 of the DOE ventilation system evaluation guidance document.[3]

The information in Table 1 of Attachment 2 was submitted to the DOE Independent Review Panel (IRP) in December 2006. In that submittal, a commitment was made to compare the ventilation system design to the criteria for safety-significant systems. The IRP has not issued the referenced letter of concurrence at the time this evaluation report was due. Attachment 3 is provided as a placeholder for the IRP report when it is submitted.

The consequences listed in Table 1 of Attachment 2 were developed using the Radiological Safety Analysis Computer (RSAC)-5 code. RSAC-5 is an INL-developed code for estimating the potential radiation doses to maximally exposed individuals from accidental releases of radioactive material. The current approved simulation modeling code to determine the radiological consequences from postulated facility accidents resulting in airborne releases to the environment is the MELCOR Accident Consequence Code System 2 (MACCS2). MACCS2 is designated as a "toolbox" code by the U.S. Department of Energy for safety applications. The code uses well-established scientific and engineering principles as the basis for various calculational steps. The FSA DSA[1] is currently undergoing an annual update (Revision 7), in which the MACCS2 code is used to estimate potential radiation doses to maximally exposed individuals from accident releases of radioactive material. Table 2 of Attachment 2 provides a summary of postulated FSA accident frequencies and consequences without controls using the MACCS2 code. Table 3 of Attachment 2 is provided here for the purpose of providing a comparison with existing accident results (RSAC) and updated results (MACCS2) that will be presented in the upcoming FSA DSA annual update. Accident conclusions do not change as a result of using the MACCS2 code.

2.3 Summary

The hazard and accident analyses in the DSA do not credit the confinement ventilation system for any event; therefore, the system is not designated safety-significant or safety-class and functional requirements and performance criteria are not identified. The ventilation system provides protection for workers under the purview of the radiation protection program (contamination control). Further evaluation will apply safety-significant criteria in accordance with DOE evaluation guidance for safety-significant systems.

3. SYSTEM EVALUATION

The Site Evaluation Team and the Facility Evaluation Team 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.[4] All the applicable nondiscretionary attributes of a safety-significant system were considered mandatory by the Site and Facility Evaluation Teams.

The system evaluation involved a review of the Fire Hazards Analysis, "Fire Safety Assessment for CPP-666, Fluorinel Dissolution Process and Fuel Storage Facility (FAST),"[5] and the DSA.[1] A facility walk down was performed by the Facility and Site Evaluation Teams.

Attachment 4 shows the results of the facility ventilation system evaluation against the criteria for safety-significant systems. The system evaluation results demonstrate that these systems meet each nondiscretionary attribute of a safety-significant system in all cases.

4. CONCLUSION

Based on the results of the hazard and accident analyses, the INTEC FSA confinement ventilation system (CVS) is not required to be designated as safety-significant or safety-class. The ventilation system is defense-in-depth for protection for workers under the purview of the radiation protection program (contamination control). The system was evaluated against the performance attributes expected of safety-significant ventilation systems and meets all of those attributes.

5. REFERENCES

1. SAR-113, "Safety Analysis Report for the CPP-666 Fuel Storage Area (FSA)," Rev. 6, November 16, 2006.

2. LST-335, "Approved Cask List for the CPP-666 Fuel Storage Area (FSA)," Rev. 2, August 17, 2006.

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

4. 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.

5. HAD-316, "Fire Safety Assessment for CPP-666, Fluorinel Dissolution Process and Fuel Storage Facility (FAST)," Idaho Cleanup Project, Rev. 2, February 27, 2007.

Attachment 1

Facility Evaluation Team Biographical Sketches

Jeff Harvey
Safety Basis Subject Matter Expert

Mr. Harvey is the Director of Nuclear Safety for CH2M-WG Idaho, LLC (CWI). He provides senior-level technical and strategic guidance to the nuclear safety program. His experience includes providing operational, design, and regulatory support in safety basis development to many Department of Energy sites, such as Oak Ridge, Lawrence Livermore, Los Alamos, Savannah River Site, Pantex, the Waste Isolation Pilot Plant, and the Idaho National Laboratory. Mr. Harvey has also supported these DOE sites in the areas of project and resource management and oversight for decommissioning and decontamination activities. Mr. Harvey has over 23 years experience in the Department of Energy and Department of Defense complexes, with 16 years in the nuclear industry, including experience in systems engineering, project management, regulatory engineering, and nuclear safety analysis. He has a bachelor's degree in electronics engineering from Fairmont State College and a master of science degree in administrative science from John Hopkins University.

Bruce Becker
Facility Safety Basis Subject Matter Expert

Mr. Becker is a Nuclear Safety analyst for the CWI Nuclear Material Disposition, which includes the Idaho Nuclear Technology and Engineering Center Fuel Storage Area. He is responsible for providing nuclear safety support. Mr. Becker has 14 years experience at the Idaho National Laboratory. He has a master of science degree in environmental engineering from the University of Texas.

Dale Jolly
INTEC Fuel Storage Area System Engineer

Mr. Jolly is a systems engineer for the CWI Nuclear Material Disposition facilities. He has recently been assigned systems engineering responsibility for the CPP-666 heating, ventilating, and air conditioning, steam, and condensate systems as well as the CPP-2710 HVAC system, which serves CPP-603, including the Irradiated Fuel Storage Facility. He provides technical expertise for assigned systems to include development of technical and functional requirements to design personnel concerning system modification, configuration management, and operations, planning and maintenance support when required. He also performs preliminary unreviewed safety question (USQ) evaluations for work orders and facility change forms on assigned systems. Mr. Jolly has 27 years experience at the Idaho Nuclear Technology and Engineering Center in various capacities and has served as a system engineer for the Spent Nuclear Fuel/Nuclear Material Disposition organization for various Irradiated Fuel Storage Facility mechanical systems since September 2002. He has a bachelor's degree in chemical engineering from the University of Delaware and a master of engineering degree in chemical engineering from the University of Idaho.

Attachment 2

System Functional Classification Table (Table 4.3)

Table 1. Confinement information from the INTEC Fuel Storage Area DSA (RSAC).[a]

INTEC Fuel Storage Area			Hazard Category 2				CVS Performance Expectations			
	Confinement Type		Unmitigated Bounding Doses -RSAC (rem)	Confinement Classification						
Bounding Accidents	Active	Passive		SC	SS	Defense In-depth	Function	Functional Requirements	Performance Criteria	Compensatory Measures
HEPA filter Failure	None credited	None credited	100 m = 4.2E-06 Plume on ground = 1.3E-02 13.7 km = 4.9E-03 LPF = 1.0	None required	None required	None required	NA	NA	NA	NA
Total fuel cladding failure	None credited	Non credited	100 m = 2.1E+00 13.7 km = 1.0E-01 LPF = 1.0	None required	None required	None required	NA	NA	NA	NA
Spent resin release	None credited	None credited	100 m = 6.6E-01 13.7 km = 5.2E-03 LPF = 1.0	None required	None required	None required	NA	NA	NA	NA
Inadvertent nuclear criticality	None credited	None credited	100 m = 9.8E+00 13.7 km = 1.8E-02 LPF = 1.0	None required	None required	None required	NA	NA		
FSA aboveground structure failure	None credited	None credited	100 m = 2.1E+01 13.7 km = 1.0E+00 LPF = 1.0	Aboveground structures	None required	None required	NA	NA	NA	NA
FSA pool drain	None credited	None credited	100 m = 3.3E+03 13.7 m = 2.2E+02 LPF = 1.0	None required	None required	None required	NA	NA	NA	NA

DSA documented safety analysis
FSA Fuel Storage Area
HEPA high-efficiency particulate air
INTEC Idaho Nuclear Technology and Engineering Center
LCO limiting condition for operations
LPF leak path factor
NA not applicable
SC safety class
SS safety significant

a. Corresponds with Table 4.3 of "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.

Table 2. Summary of postulated FSA accident frequencies and consequences without controls (MACCS2).[a]

Accident Scenario	Freq.	Radiological Dose - MACCS2 (rem)		Risk Class		Summary of Required Controls (facility worker controls established by the hazard evaluation are not included)
		CW	MOI	CW	MOI	
HEPA filter failure	U	4.1E+00	7.1E-04	III	III	None
Total fuel cladding failure	A	2.6E+00	4.9E-04	III	III	No new controls from accident analysis
Spent resin release (fire)	U	3.3E+00	7.2E-04	III	III	No new controls from accident analysis
Underwater inadvertent criticality (10-ft water shield)	A	2.1E-01	5.6E-05	III	III	No new controls from accident analysis
FSA aboveground structure failure	U	2.6E+01	4.9E-03	II	III	No new controls from accident analysis
FSA pool drain	U	3.3E+03	5.2E-01	I	III	No new controls from accident analysis
Cask transfer drop[b]	U	6.1E+01	1.1E-02	II	III	No new controls from accident analysis
Cask transfer inadvertent criticality[b]	BEU	2.2E+03	2.8E-01	III	IV	No new controls from accident analysis

a. Information taken from DRAFT SAR-113 Rev. 7, Table 3-7.
b. New scenarios in DRAFT SAR-113 for cask transfer – Not in building so no included in comparison to previous results

Table 3. Comparison of Results of the RSAC and MACCS2 Codes.

INTEC Fuel Storage Area			Hazard Category 2					CVS Performance Expectations			
Bounding Accidents	Confinement Type		Unmitigated Bounding Doses (rem)		Confinement Classification			Function	Functional Requirements	Performance Criteria	Compensatory Measures
	Active	Passive	RSAC	MACCS2	SC	SS	Defense In-depth				
HEPA Filter Failure	None credited	None credited	100 m = 4.2E-06 Plume on ground = 1.3E-02 13.7 km = 4.9E-03 LPF = 1.0	100 m = 4.1E+00 Plume on ground = N/A 13.7 km = 7.1E-04 LPF = 1.0	None required	None required	None required	Not Applicable (NA)	NA	NA	NA
Total Fuel Cladding Failure	None Credited	Non credited	100m = 2.1E+00 13.7 km = 1.0E-01 LPF = 1.0	100m = 2.6E+00 13.7 km = 4.9E-04 LPF = 1.0	None required	None required	None required	NA	NA	NA	NA
Spent resin release	None credited	None credited	100 m = 6.6E-01 13.7 km = 5.2E-03 LPF = 1.0	100 m = 3.3E+00 13.7 km = 7.2E-04 LPF = 1.0	None required	None required	None required	NA	NA	NA	NA
Inadvertent nuclear criticality	None credited	None credited	100 m = 9.8E+00 13.7 km = 1.8E-02 LPF = 1.0	100 m = 2.1E-01 13.7 km = 5.6E-05 LPF = 1.0	None required	None required	None required	NA	N/A	NA	NA
FSA above ground structure failure	None credited	None credited	100 m = 2.1E+01 13.7 km = 1.0E+00 LPF = 1.0	100 m = 2.6E+01 13.7 km = 4.9E-03 LPF = 1.0	None required	None required	None required	NA	NA	NA	NA
FSA pool drain	None credited	None credited	100 m = 3.3E+03 13.7 m = 2.2E+00 LPF = 1.0	100 m =3.3E+03 13.7 m = 5.2E-01 LPF = 1.0	None required	None required	None required	NA	NA	NA	NA

FSA	Fuel Storage Area
HEPA	high-efficiency particulate air
LCO	limiting condition for operations
LPF	leak path factor
MACCS2	MELCOR Accident Consequence Code System 2
RSAC	Radiological Safety Analysis Computer
SC	safety class
SS	safety significant

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 Table (Table 5.1)

CONFINEMENT VENTILATION SYSTEM COMPARISONS 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 by accident analysis to control hazardous material release; demonstrate by use considering potential in-leakage.	The accident analysis in the DSA does not credit contamination zone pressure differentials to control hazardous material releases. The design documents show the criteria are met by the current design which specifies: "To provide confinement of radioactivity, the ventilation system for the entire facility shall be designed such that air flows from areas of lower contamination potential to areas of higher potential contamination. To assure the proper air flow direction, pressure differentials shall be maintained between confinement zones. Areas of continuous personnel occupancy shall be maintained at least 0.1 in. H_2O less than atmospheric pressure. The next level of contamination potential is the fuel handling and transfer area, the fuel storage basin area, and the cask decontamination area, which should be maintained at least 0.2 in. H_2O less than areas of continuous personnel occupancy. The areas of highest contamination potential are the water chemistry control area and the fuel cutting and preparation area; these shall be maintained at least 0.7 in. H_2O less than the area of continuous personnel occupancy and at least 0.5 in. H_2O less than the storage basin area. It shall also be possible to reduce the air flow over the pools as necessary to avoid surface ripples interfering with viewing operations. Contamination spread from the Fluorinel dissolution process to the FSA shall be minimized by maintaining the process cell pressures at 0.5 to 1.0 in. H_2O less than the pressure in the fuel cutting area."	SAR-113 Rev. 6, "Safety Analysis Report for the CPP-666 Fuel Storage Area (FSA)," November 16, 2006. ENI-104, "Design Criteria for the Fuel Storage Area of the FAST Facility" Rev. 4, February 1982. Section 4.6.1
Materials of construction should be appropriate for normal, abnormal and accident conditions	None.	The system was designed and constructed to handle the off-gas from the Fluorinel Dissolution Process. The systems are also designed for fires and the design basis earthquakes.	SAR-113 Rev. 6, "Safety Analysis Report for the CPP-666 Fuel Storage Area (FSA), November 16, 2006.
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 system is not credited in any accident scenario. The accident analysis in the DSA does not credit the exhaust systems capabilities of withstanding abnormal and accident system conditions to maintain integrity.	SAR-113 Rev. 6, "Safety Analysis Report for the CPP-666 Fuel Storage Area (FSA)," November 16, 2006.

FSA CONFINEMENT VENTILATION SYSTEM EVALUATION

CONFINEMENT VENTILATION SYSTEM COMPARISONS TO PERFORMANCE CRITERIA			
EVALUATION CRITERIA	**CRITERIA EXPLANATION**	**COMPARISON TO CRITERIA**	**REFERENCE**
CVSs 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 system is not credited to minimize release. The design documents show the system meets the criteria for: 1) type of filter – HEPA filters are used 2) filter size – Air flow provides required pressure drop 3) decontamination factor – No credit is take for decontamination factor	SAR-113 Rev. 6, "Safety Analysis Report for the CPP-666 Fuel Storage Area (FSA), November 16, 2006. Technical Specifications for Fluorinel Dissolution Process and Metal-Clad Storage Facility, Section HVAC1-02.
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).	The design documents show the system meets the criteria: 4.6.5 Instrumentation and Control. Devices shall be provided to control and indicate pressure differentials between confinement zones. Alarms shall be provided in the control room to indicate when pressure differentials are not within the prescribed range. Instrumentation shall be installed to monitor filter pressure drops, airflow, air temperature, air radioactivity, fire (heat and/or smoke), and the status (on/off) of blowers, dampers, etc. Alarms shall be provided where appropriate, and standby electrical power shall be supplied to essential components. Interlocks shall be provided to permit a supply blower to start or continue to operate only after an exhaust blower has been started and is operating, thus preventing pressurizing the facility.	ENI-104, "Design Criteria for the Fuel Storage Area of the FAST Facility" Rev. 4, February 1982.
Interlock supply and exhaust fans to prevent positive pressure differential	None.	The design includes interlocks between the supply and exhaust. From SAR-113: • "A backflow damper downstream of each fan is interlocked with the supply fans and closes when the fan is de-energized." • "An interlock ensures that the inlet supply fans do not operate if the supply inlet damper closes or if one of the two operating final exhaust fans shuts down. The supply fans also cease operating on loss of normal power. In order for the supply fans to be started, the following three conditions must be met: (1) the supply damper must be open,	SAR-113 Rev. 6, "Safety Analysis Report for the CPP-666 Fuel Storage Area (FSA)," November 16, 2006.

CONFINEMENT VENTILATION SYSTEM COMPARISONS TO PERFORMANCE CRITERIA

EVALUATION CRITERIA	CRITERIA EXPLANATION	COMPARISON TO CRITERIA	REFERENCE
		(2) two of the three final exhaust fans must be operating, and (3) normal power must be available." "The fan motors, variable pitch fan intake vanes, isolation dampers, and stack bypass relief are automatically activated and interlocked. Alarms sound if pressure differentials exceed either high or low settings or if airflow drops below the operating limit setting. The final exhaust fans also shut down if there is low flow, and they cannot restart until they are manually reset. During the period between loss of normal power and load pick up by standby power, the exhaust fans cease operating and the isolation dampers close. Exhaust fans restart when power becomes available. If one of the two operating exhaust fans fails to start or fails after starting, the standby exhaust fan starts automatically."	
Postaccident indication of filter break-through	Instrumentation supports postaccident planning and response: should be considered critical instrumentation for safety class.	The design documents show the system meets the criteria: "Instrumentation shall be installed to monitor filter pressure drops, air flow, air temperature, air radioactivity, fire (heat and/or smoke), and the status (on/off) of blower, dampers, etc. Alarms shall be provided where appropriate, and standby electrical power shall be supplied to essential components." This equipment is not credited in the DSA.	ENI-104, "Design Criteria for the Fuel Storage Area of the FAST Facility," Rev. 4, February 1982.
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 by the use of standby or redundant equipment.	SAR-113 Rev. 6, "Safety Analysis Report for the CPP-666 Fuel Storage Area (FSA)," November 16, 2006.
Control components should fail safe	None.	The system design documents specify a fail safe design. Specifically Section 4.6.4.6 states "The ventilation system shall be designed so that failure of any one component (equipment or control device) will not affect its continued operation as a confinement system." Section 4.6.4.7 states "The ventilation system exhaust blowers shall be automatically supplied with electrical power by the standby power distribution system in the event of a failure of normal power."	ENI-104, "Design Criteria for the Fuel Storage Area of the FAST Facility" Rev. 4, February 1982.

CONFINEMENT VENTILATION SYSTEM COMPARISONS TO PERFORMANCE CRITERIA			
EVALUATION CRITERIA	**CRITERIA EXPLANATION**	**COMPARISON TO CRITERIA**	**REFERENCE**
Resistance to Internal Events - Fire			
CVSs 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.	CPP-666 is not a new facility. The ventilation system is not credited for any scenario in the hazard or accident analysis sections. To the extent possible, the system is constructed of fire-resistant materials.	Technical Specifications for Fluorinel Dissolution Process and Metal-Clad Storage Facility, Section HVAC1-02.
CVSs 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.	CPP-666 is not a new facility. The ventilation system is not credited for any scenario in the hazard or accident analysis sections. It is not credited for preventing the propagation of a fire.	SAR-113 Rev. 6, "Safety Analysis Report for the CPP-666 Fuel Storage Area (FSA)," November 16, 2006.
Resistance to External Events – Natural Phenomena - Seismic			
CVSs should safely withstand earthquakes	If the active CVS is not credited in a seismic accident condition, there is no need to evaluate that performance and/or design attribute for the CVS (discretionary). Also, any seismic impact on the CVS 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 not credited for any scenario in the hazard or accident analysis sections. It is not credited in a seismic accident. Based on a comparison between the original facility design criteria and the current criteria, the FSA design meets those for a PC-3 facility. "Equipment designated in Table HVAC1-01.2 shall be designed to withstand Earthquakes of the intensity specified herein with no loss of structural integrity for spectra designated DBE or with no loss of operability for spectra designated OBE." "…be designed to withstand a Design Basis Earthquake (DBE), having a resultant horizontal bedrock acceleration at ICPP of 0 .24g, and a resultant vertical bedrock acceleration of 0.16g. The spectrum given in Regulatory Guide 1 .60, "Design Response Spectrum for Seismic Design of Nuclear Power Plants," shall be utilized. The Facility shall be equipped with two triaxial strong-motion accelerographs installed as recommended in Regulatory Guide 3.17. All other portions of the storage area shall be designed in accordance with the Uniform Building Code Seismic Risk Zone 3 criteria."	SAR-113 Rev. 6, "Safety Analysis Report for the CPP-666 Fuel Storage Area (FSA)," November 16, 2006. Technical Specifications for Fluorinel Dissolution Process and Metal-Clad Storage Facility, Section HVAC1-01. ENI-104, "Design Criteria for the Fuel Storage Area of the FAST Facility," Rev. 4, February 1982.

CONFINEMENT VENTILATION SYSTEM COMPARISONS TO PERFORMANCE CRITERIA			
EVALUATION CRITERIA	**CRITERIA EXPLANATION**	**COMPARISON TO CRITERIA**	**REFERENCE**
Resistance to External Events – Natural Phenomena – Tornado/Wind			
Confinement ventilation system should safely withstand tornado depressurization.	If the active CVS is not credited in a tornado condition, there is no need to evaluate that performance and/or design attribute for the CVS (discretionary). Also, any tornado impact on the CVS performance will be based on the current functional requirement in the DSA.	The ventilation system is not credited for any scenario in the hazard or accident analysis sections. It is not credited in a tornado condition. DOE-STD-1020-2002 does not identify tornado criteria for the INL. The design documents show the system meets the criteria: Those features of the facility necessary to maintain the plant in a safe condition without undue risk to the health and safety of operating personnel and the public "...shall be designed to withstand the tornadic conditions : (1) Maximum wind velocity 175 mph (2) Rotational velocity 145 mph (3) Maximum translational velocity 30 mph (4) Pressure drop 0 .65 psi (5) Pressure drop rate 0 .25 psi/sec. The following tornado-generated missiles shall be assumed for impact and penetration design bases: (1) Wood plank, 4 in. by 12 in. by 12 ft long, weighing 180 lb, striking end on. (2) A 2,000-lb compact car tumbling along the ground at 65 mph. Structural requirements for impact and penetration resistance shall be determined in accordance with "ICPP Minimum Basis for Design analysis," issued June, 1976."	SAR-113 Rev. 6, "Safety Analysis Report for the CPP-666 Fuel Storage Area (FSA)," November 16, 2006. ENI-104, "Design Criteria for the Fuel Storage Area of the FAST Facility," Rev. 4, February 1982.
CVSs should withstand design wind effects on system performance	If the active CVS is not credited in a wind condition, there is no need to evaluate that performance and/or design attribute for the CVS (discretionary). Also, any wind impact on the CVS performance will be based on the current NP analysis in the DSA.	The ventilation system is not credited for any scenario in the hazard or accident analysis sections. It is not credited in a wind condition. The original FSA design criteria for extreme wind loadings are summarized in SAR-113 Table 1-1 and include: • Normal wind conditions per the UBC • The 100-year wind (100 mph) • The DBT and associated tornado-generated missiles. The original FSA design criteria for extreme winds are more stringent than the current PC-3 design criteria.	SAR-113 Rev. 6, "Safety Analysis Report for the CPP-666 Fuel Storage Area (FSA)," November 16, 2006.

CONFINEMENT VENTILATION SYSTEM COMPARISONS TO PERFORMANCE CRITERIA			
EVALUATION CRITERIA	**CRITERIA EXPLANATION**	**COMPARISON TO CRITERIA**	**REFERENCE**
Other NP Events (e.g., flooding, precipitation)			
CVS should withstand other NP events considered credible in the DSA where the CVS is credited	If the active CVS is not credited for this event there is no need to evaluate that performance and/or design attribute for the CVS (discretionary). Also, any impact on the CVS performance will be based on the current NP analysis in the DSA.	The ventilation system is not credited for any scenario in the hazard or accident analysis sections. It is not credited in any natural phenomena condition.	SAR-113 Rev. 6, "Safety Analysis Report for the CPP-666 Fuel Storage Area (FSA)," November 16, 2006.
Range Fires/Dust Storms			
Administrative controls should be established to protect CVSs 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, and procedures and fire hazards analyses are performed and for maintaining approved emergency response procedures.	TSR-100, "ICP Standardized Technical Safety Requirements (TSR) Document."
Testability			
Design supports the periodic inspection and testing of filters and housing, and tests and inspections are conducted periodically	Ability to test for leakage per intent of ASME N510.	The design of the facility ventilation systems includes ports for testing the integrity and installation of HEPA filters in the exhaust plenums.	Technical Specifications for Fluorinel Dissolution Process and Metal-Clad Storage Facility, Section HVAC1-02. TPR-5054, HEPA Filter In-Place Testing.

CONFINEMENT VENTILATION SYSTEM COMPARISONS TO PERFORMANCE CRITERIA			
EVALUATION CRITERIA	**CRITERIA EXPLANATION**	**COMPARISON TO CRITERIA**	**REFERENCE**
Instrumentation required to support system operability is calibrated	Credited instrumentation should have specified calibration/surveillance requirements. Nonsafety instrumentation should be calibrated as necessary to support system functionality.	The DSA for the IFSF does not credit ventilation system instrumentation in any accident scenario. Instrument calibration is governed by MCP-1292, INTEC Administration of Instrument Calibrations.	MCP-1292, INTEC Administration of Instrument Calibrations (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 of IFSF HVAC systems are specified in procedures. Periodic testing of blowers is also specified in procedures. The accident analysis in the DSA does not identify required responses for the ventilation system.	TPR-6979, "Operate FAST HVAC System."
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 CPP-666 filter components are specified in procedures. Filters are replaced if in-place testing indicates filter damage or leakage.	TPR-7146, "Replace Off-gas Filter Components." TPR-5054, "HEPA Filter in Place Testing."

CONFINEMENT VENTILATION SYSTEM COMPARISONS TO PERFORMANCE CRITERIA

EVALUATION CRITERIA	CRITERIA EXPLANATION	COMPARISON TO CRITERIA	REFERENCE
		Single Failure	
Failure of one component (equipment or control) shall not affect continuous operation	Criteria do 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 do 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 CVS	None.	The design documents show the system meets the criteria: The standby electrical power distribution system shall supply power to those systems and equipment items necessary to place and maintain the FSA and the Fluorinel process in a "safe shutdown" status. Conditions for safe shutdown status include: … (3) ventilation systems shall be operative…	ENI-104, "Design Criteria for the Fuel Storage Area of the FAST Facility" Rev. 4, February 1982.

ASME	American Society of Mechanical Engineers	INL	Idaho National Laboratory
CVS	confinement ventilation system	MCP	management control procedure
DBE	design basis earthquake	NP	natural phenomena
DBT	design basis tornado	OBE	operating basis earthquake
DOP	detailed operating procedure	PBF	Power Burst Facility
DSA	documented safety analysis	PC	performance criteria
ENI	Exxon Nuclear Internal Report	SAR	Safety Analysis Report
FAST	Fluorinel Dissolution Process and Fuel Storage	SSC	structure, system, and component
FSA	Fuel Storage Area	TAN	Test Area North
HEPA	high-efficiency particulate air	TPR	technical procedure
HVAC	heating ventilating, and air conditioning	TSR	technical safety requirement
ICP	Idaho Cleanup Project	UBC	Uniform Building Code

Idaho Cleanup Project

INTEC Irradiated Fuel Storage Facility (CPP-603) Ventilation System Evaluation

July 2007

Idaho Cleanup Project

INTEC Irradiated Fuel Storage Facility (CPP-603) Ventilation System Evaluation

July 2007

REVIEWS AND APPROVALS

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EXECUTIVE SUMMARY

The 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).

The evaluation for the Idaho Nuclear Technology and Engineering Center (INTEC) Irradiated Fuel Storage Facility 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 in December 2006. Phase II involved a ventilation system evaluation using DOE guidance document Table 5.1 and associated evaluation criteria and was submitted to the IRP for review in February 2007. Phase III involved completion of the final evaluation report and submittal to the IRP.

The INTEC Irradiated Fuel Storage Facility (CPP-603) is Hazard Category 2 and is designed with a combination of passive structures and a ventilation system for contamination control and worker protection. The documented safety analysis (DSA) does not require that the ventilation system be a safety-significant or safety-class system, structure or component (SSC). Therefore, functional requirements and performance criteria are not identified for the confinement ventilation system.

Per the evaluation guidance for Hazard Category 2 facilities, the performance criteria for safety-significant ventilation systems are used to evaluate the ventilation system. The result of the evaluation is that the design features of the facility ventilation system meets the nondiscretionary performance criteria for safety-significant ventilation systems, as specified in Table 5.3 of the DOE evaluation guidance document. See Section 3 for more information.

CONTENTS

ACRONYMS

CVS	confinement ventilation system
CWI	CH2M–WG Idaho, LLC
D&D	decontamination and decommissioning
DNFSB	Defense Nuclear Facilities Safety Board
DOE	Department of Energy
DSA	Documented Safety Analysis
FCS	fuel conditioning station
HEPA	high-efficiency particulate air
HVAC	heating, ventilating, and air conditioning
IFSF	Irradiated Fuel Storage Facility
INL	Idaho National Laboratory
INTEC	Idaho Nuclear Technology and Engineering Center
IRP	Independent Review Panel
LPF	leak path factor
MACCS2	MELCOR Accident Consequence Code System 2
NPH	natural phenomena hazard
PC	performance category
PCS	permanent containment structure
RSAC	Radiological Safety Analysis Computer
SAR	Safety Analysis Report
SC	safety class
SDD	system design description
SO	system operability
SS	safety significant
SSC	system, structure, or component

TFR	technical and functional requirement
TPR	Technical Procedure
UBC	Uniform Building code

INTEC Irradiated Fuel Storage Facility Ventilation System Evaluation

1. INTRODUCTION

The following sections provide a facility overview of the Idaho Nuclear Technology and Engineering Center (INTEC) Irradiated Fuel Storage Facility (IFSF) and an overview of the confinement ventilation system (CVS) strategy.

1.1 Facility Overview

The IFSF 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 and the potential for an inadvertent nuclear criticality.[1] The IFSF is located at the INTEC area of the Idaho National Laboratory (INL). Construction of the IFSF was completed in December of 1974. The IFSF was designed to provide safe, interim, fuel storage pending retrieval of the stored fuel for final disposal. To meet this goal, the main operations performed in the IFSF include receiving spent nuclear fuels from other facilities, repackaging and conditioning fuels for interim storage, safely storing fuels, and packaging fuels for removal from the facility. The facility mission will continue until all fuels have been removed. It is projected that the facility will continue to store fuel until 2035.

The IFSF is located in Building CPP-603 in the southwest corner of the INTEC. Building CPP-603 consists of the IFSF, the Basin Facility, and common truck bays with overhead crane systems. The Basin Facility consists of three water-filled basins constructed in the 1950s as the original fuel storage facility at the INTEC. The fuel storage basins do not meet current underwater fuel storage facility standards, and all known fuel inventories have been removed. At present, the fuel storage basins are filled with grout and the support systems are undergoing decontamination and decommissioning (D&D) activities.

The IFSF functional areas include the (1) cask receiving area, (2) cask transfer pit and permanent containment structure (PCS), (3) fuel handling cave, (4) fuel storage area, (5) control room/instrument room, and (6) crane maintenance area. In addition to these functional areas, other miscellaneous IFSF support areas include a standby generator room (inactive); a heating, ventilating, and air conditioning (HVAC) equipment area; and an access building area.

Fuel and shipping packages are moved into and out of the fuel handling cave via the cask transfer car pit. During receipt, a fuel package is placed on the cask transfer car with the crane. Then the cask transfer car is moved under the fuel handling cave wall into the fuel handling cave. The PCS covers the cask transfer pit in the cask receiving area for contamination confinement. Venting and decontamination of the cask may be conducted in the PCS. A sump and sump pump are located in the bottom of the cask transfer car pit to collect and pump out any water that might drain from the fuel handling cave, truck ramp, or fuel storage area.

Operations performed in the fuel handling cave include remote handling of cask lids, handling of fuel packages, examining fuel with the in-cell examination system, and repackaging of fuel for storage or shipment. Some nuclear fuels received at the IFSF require treatment in the fuel conditioning station (FCS), which was formerly known as the fuel canning station. The FCS is located in the fuel handling cave.

The fuel storage area contains a storage rack that provides spacing and support for the fuel storage canisters. The storage rack maintains a staggered spacing of canisters for criticality purposes. Fuel is moved into the fuel storage area in fuel storage canisters through the shuttle bin. The canister is placed in its designated position in the storage rack using a crane.

The control room overlooks the fuel handling cave and the fuel storage area. Operation of the electromechanical manipulator, in-cell examination system, FCS, cranes, fuel-shuttle bin, cask transfer car, closed-circuit television, ventilation system, communication, and lighting can be controlled from the control room.

The crane maintenance area provides space where cranes and other equipment can be maintained and stored. A personnel door to the crane maintenance area provides access to the crane maintenance area and the fuel handling cave via a shielding labyrinth.

1.2 Confinement Ventilation Strategy

At the IFSF, two or more barriers generally are present to limit potential releases of radioactive material. The IFSF includes the following design features or systems for confinement of radioactive materials:

- **Fuel cladding and/or fuel can and fuel storage canister**. The design philosophy for fuel storage in the IFSF was that the fuel storage canister would provide the principal barrier to the release of fission products, and that the facility design would preclude a massive failure of the canister while stored in the fuel storage area. The fuel canisters are not sealed, but the lid cannot be removed under normal storage conditions. Many fuels stored at the IFSF contain cladding. Depending on its condition, cladding can provide an added layer of confinement. In addition, some fuels that are in a readily dispersable form are contained in cans.

- **Shipping casks and containers.** The fuel shipping casks are designed to provide shielding, and in some cases, containment or confinement of gases, liquids, or solids.

- **Building ventilation system.** Building ventilation is designed to maintain pressure within the areas in the IFSF below atmospheric pressure to ensure that particulate matter is directed away from workers in the facility.

- **IFSF building.** The physical structure of the IFSF provides the final confinement barrier between the stored fuel and the environment. The IFSF building is designed to withstand design basis extreme winds and a design basis earthquake, and to maintain its integrity during postulated design basis events for the IFSF.

1.2.1 CPP-603 Irradiated Fuel Storage Facility Ventilation System

The primary function of the fuel storage area and fuel handling cave ventilation system is to maintain a slightly negative pressure, thus preventing the spread or release of radioactive contamination. The system was originally designed to provide cooling for reactor fuel with high rates of heat generation from radioactive decay. As the facility mission has changed, the heat load from the radioactive decay of the stored fuel has been drastically reduced from that originally projected. For current and future projected fuel inventories, it has been shown that facility and fuel temperatures will remain well below levels where either the facility or stored fuel could suffer harmful effects, even with the ventilation system not operating at all. Therefore, decay heat removal is no longer a required function of the ventilation system.

The fuel storage area and fuel handling cave ventilation system consists of supply filters; blowers and dampers; ducting to direct the air supply to the west end of the IFSF storage area rack; ducting on the east side of the storage area rack to direct the exhaust air out of the storage area; prefilters; high-efficiency particulate air (HEPA) filters; exhaust blowers; and an exhaust stack. The fuel handling cave has a separate exhaust plenum with prefilters, and ducting that joins the main exhaust ducting.

All supply filters, the main exhaust filters, and the supply and exhaust blowers are on a concrete pad adjacent to the north side of the IFSF. A metal building, CPP-2710 shelters these components from the environment. Supply and exhaust ducting are partially underground. A more detailed description of the fuel storage area and fuel handling cave ventilation system is given in System Design Description (SDD)-117.

The ventilation system may be operated with or without the supply blowers, which is a different operation than the original design. Airflow patterns have been measured and analyzed, and the analysis concludes that operation of the system without the supply blowers is acceptable.

The original design criteria for IFSF features important to safety was 0.33 g bedrock acceleration with an amplification factor of 1.3 (total design load of 0.43 g). This meets Performance Category (PC)-4 acceleration criteria of 0.187 g horizontal and 0.144 g vertical. The other IFSF features were designed to Seismic Risk Zone 3 of the Uniform Building Code (UBC), 1970 Edition. There have been re-evaluations and modifications of the facility to withstand seismic events. The portions of the ventilation system mounted on the roof (including the stack) meet the current design criteria of PC-2. The new portions of the ventilation system are designed to PC-2 per Technical and Functional Requirement (TFR)-176, Rev. 1 with the new enclosure structure classified as PC-1.

1.3 Major Modifications

The CPP-603 ventilation systems are not being modified.

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 IFSF ventilation systems are documented in the IFSF documented safety analysis (DSA).[1] 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. For all accidents assessed in Section 3.4 of SAR-114, no credit was taken for the building structures of the IFSF or for an approved cask to prevent or minimize release of radioactive material. For all accidents within the fuel handling cave or fuel storage area, the ventilation system is assumed to be operational during this accident. The result is a release through the stack, but because of the low stack height relative to surrounding building structures, the releases are modeled as ground-level releases. The radioactive material release is conservatively assumed to be instantaneous into the fuel handling cave, and then released to the environment exponentially via the ventilation system. No credit is taken for HEPA filtration in any of the analyzed accidents.

2.2 Evaluation

The process used in performing the functional classification evaluation was to review the 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 facility DSA evaluates credible scenarios for releases due to fire, breach of confinement, explosion, criticality, external events, and natural phenomena hazards (NPHs).

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

1. Nuclear Criticality. Ventilation provides no safety function for credible criticality scenarios. Therefore, releases from a criticality scenario are excluded from the evaluation.

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

3. Tornado. Potential releases from a tornado are excluded from Phase II evaluation. DOE-STD-1020-92, Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities,[2] specifically excludes INL facility evaluation and design for tornado hazards.

4. Lightning. Design and construction includes lightning protection. Lightning protection is a standard feature for all nuclear facilities at the INL.

5. Flooding. An active ventilation system could not be credited as a mitigative feature for a release caused by flooding.

Attachment 2 lists the classifications for each of the scenarios considered in the evaluation. The format for the classification tables in Attachment 2 is derived from Table 4.3 of the DOE ventilation system evaluation guidance document.[3]

The information in Table 1 of Attachment 2 was submitted to the DOE Independent Review Panel (IRP) in December 2006. In that submittal, a commitment was made to compare the ventilation system design to the criteria for safety-significant systems The IRP has not issued the referenced letter of concurrence at the time this evaluation report was due. Attachment 3 is provided as a placeholder for the IRP report when it is submitted.

Table 1 of Attachment 2 was developed using the Radiological Safety Analysis Computer (RSAC)-5 code. RSAC-5 is an INL-developed code for estimating the potential radiation doses to maximally exposed individuals from accidental releases of radioactive material. The current approved simulation modeling code to determine the radiological consequences from postulated facility accidents resulting in airborne releases to the environment is the MELCOR Accident Consequence Code System 2 (MACCS2). MACCS2 is designated as a "toolbox" code by the U.S. Department of Energy for safety applications. The code uses well-established scientific and engineering principles as the basis for various calculational steps. The IFSF DSA[2] is currently undergoing approval of an annual update (Revision 11) in which the MACCS2 code is used to estimate potential radiation doses to maximally exposed individuals from accident releases of radioactive material. Table 2 of Attachment 2 provides a summary of postulated IFSF accident frequencies and consequences without controls using the MACCS2 code. Table 3 of Attachment 2 is provided herein for the purpose of providing a comparison with existing accident results (RSAC) and updated results (MACCS2) that will be presented in the upcoming IFSF DSA annual update. Accident conclusions do not change as a result of using the MACCS2 code.

2.3 Summary

The hazard and accident analyses in the DSA do not credit the CVS for any event; therefore, the system is not designated safety-significant or safety-class and functional requirements and performance criteria are not identified. The ventilation system provides protection for workers under the purview of the Radiation Protection Program (contamination control). Further evaluation will apply safety-significant criteria in accordance with DOE evaluation guidance for safety-significant systems.

3. SYSTEM EVALUATION

The Site Evaluation Team and the Facility Evaluation Team 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.

The system evaluation involved a review of the Fire Hazards Analysis[4] and the DSA.[1] A facility walk-down was performed by the Facility and Site Evaluation Teams.

Attachment 4 shows the results of the facility ventilation system evaluation against the criteria for safety-significant systems. The system evaluation results demonstrate that these systems meet each attribute of a safety-significant system in all cases.

4. CONCLUSION

Based on the results of the hazard and accident analyses, the INTEC Irradiated Fuel Storage Facility CVS is not required to be designated as safety-significant or safety-class. The ventilation system is defense in-depth for protection of workers under the purview of the Radiation Protection Program (contamination control). The system was evaluated against the performance attributes expected of safety-significant ventilation systems and meets all of those attributes.

5. REFERENCES

1. SAR-114, "Safety Analysis Report for the Irradiated Fuel Storage Facility (IFSF)," Rev. 10, August 17, 2006.

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. HAD-354, "Fire Safety Assessment for INTEC Fuel Receiving, Storage, and Associated Facilities," Rev. 0, May 2005.

Attachment 1

Facility Evaluation Team Biographical Sketches

Jeff Harvey
Safety Basis Subject Matter Expert

Mr. Harvey is the Director of Nuclear Safety for CH2M-WG Idaho, LLC (CWI). He provides senior-level technical and strategic guidance to the nuclear safety program. His experience includes providing operational, design, and regulatory support in safety basis development to many Department of Energy sites, such as Oak Ridge, Lawrence Livermore, Los Alamos, Savannah River Site, Pantex, the Waste Isolation Pilot Plant, and the Idaho National Laboratory. Mr. Harvey has also supported these DOE sites in the areas of project and resource management and oversight for decommissioning and decontamination activities. Mr. Harvey has over 23 years experience in the Department of Energy and Department of Defense complexes, with 16 years in the nuclear industry, including experience in systems engineering, project management, regulatory engineering, and nuclear safety analysis. He has a bachelor's degree in electronics engineering from Fairmont State College and a master of science degree in administrative science from John Hopkins University.

Bruce Becker
Facility Safety Basis Subject Matter Expert

Mr. Becker is a Nuclear Safety analyst for the CWI Nuclear Material Disposition, which includes the Idaho Nuclear Technology and Engineering Center Fuel Storage Area. He is responsible for providing nuclear safety support. Mr. Becker has 14 years experience at the Idaho National Laboratory. He has a master of science degree in environmental engineering from the University of Texas.

Dale Jolly
INTEC Irradiated Fuel Storage Facility System Engineer

Mr. Jolly is a systems engineer for the CWI Nuclear Material Disposition facilities. He has recently been assigned systems engineering responsibility for the CPP-666 heating, ventilating, and air conditioning, steam, and condensate systems as well as the CPP-2710 HVAC system, which serves CPP-603, including the Irradiated Fuel Storage Facility. He provides technical expertise for assigned systems to include development of technical and functional requirements to design personnel concerning system modification, configuration management, and operations, planning and maintenance support when required. He also performs preliminary unreviewed safety question (USQ) evaluations for work orders and facility change forms on assigned systems. Mr. Jolly has 27 years experience at the Idaho Nuclear Technology and Engineering Center in various capacities and has served as a system engineer for the Spent Nuclear Fuel/Nuclear Material Disposition organization for various Irradiated Fuel Storage Facility mechanical systems since September 2002. He has a bachelor's degree in chemical engineering from the University of Delaware and a master of engineering degree in chemical engineering from the University of Idaho

Attachment 2

System Functional Classification Table (Table 4.3)

Table 1. Confinement information from the INTEC Irradiated Fuel Storage Facility DSA.[a]

INTEC Irradiated Fuel Storage Facility			Hazard Category 2				CVS Performance Expectations			
Bounding Accidents	Confinement Type		Unmitigated Bounding Doses - RSAC (rem)	Confinement Classification			Function	Functional Requirements	Performance Criteria	Compensatory Measures
	Active	Passive		SC	SS	Defense In-depth				
Fuel handling cave/fuel storage area fuel handling accident	None credited	None credited	100 m = 1.6E-02 13.7 km = 1.0E-03 LPF = 1.0	None required	None required	None required	NA	NA	NA	NA
Uranium hydride pyrophoric reaction	None credited	None credited	100 m = 1.3E-01 13.7 km = 3.0E-03 LPF = 1.0	None required	None required	None required	NA	NA	NA	NA
Inadvertent nuclear criticality in the fuel handling cave/fuel storage area	None credited	None credited	100 m = 6.2E+00 13.7 km = 2.2E-02 LPF = 1.0	None required	None required	None required	NA	NA	NA	NA
Fuel conditioning station overheating	None credited	None credited	100 m = 7.5E+00 13.7 km = 2.2E+00 LPF = 1.0	None required	None required	None required	NA	NA	NA	NA
Fuel handling cave/fuel storage area structure failure	None credited	None credited	100 m = 8.8E+00 13.7 km = 1.7E-01 LPF = 1.0	None required	None required	None required	NA	NA	NA	NA
Cask handling accident in cask receiving area	None credited	None credited	100 m = 4.3E+02 13.7 km = 1.9E-01 LPF = 1.0	None required	None required	None required	NA	NA	NA	NA

CVS confinement ventilation system
INTEC Idaho Nuclear Engineering and Technology Center
LPF leak path factor
NA not applicable
SC safety class
SS safety significant

a. Information taken from Table 4.3 of "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.

Table 2. Summary of postulated IFSF accident frequencies and calculated consequences without controls.[a]

Accident Scenario	Freq.	Radiological Dose – MACCS2 (rem) CW	Radiological Dose – MACCS2 (rem) MOI	Risk Class CW	Risk Class MOI	Summary of Required Controls (facility worker controls established by the hazard evaluation are not included)
Fuel handling cave/fuel storage area fuel handling accident	A	5.45E+00	8.97E-04	III	III	No new controls from accident analysis
Uranium hydride pyrophoric reaction	A	5.11E-01	8.37E-05	III	III	No new controls from accident analysis
Inadvertent nuclear criticality in the fuel handling cave/fuel storage area (3 ATR baskets)	A	5.55E-01	1.36E-04	III	III	No new controls from accident analysis
Fuel handling cave/fuel storage area structural failure[b]	U	1.56E+00	2.74E-04	III	III	No new controls from accident analysis
Cask handling accident in cask receiving area with entire cask contents released	U	2.25E+01	1.30E-02	III	III	No new controls from accident analysis

a. Information taken from DRAFT SAR-114 Rev. 11, Table 3-7.

b. Because the extent of the damage from the failure of the fuel storage area or fuel handling cave cannot be reasonably estimated, the actual extent of the consequences could be higher or lower.

A anticipated
ATR Advanced Test Reactor
CW co-located worker
MOI maximally exposed off-Site individual (off-Site public)
U unlikely

Table 3. Comparison of results of the RSAC and MACCS2 Codes

INTEC Irradiated Fuel Storage Facility			Hazard Category 2					CVS Performance Expectations			
Bounding Accidents	Confinement Type		Unmitigated Bounding Doses (rem)		Confinement Classification			Function	Functional Requirements	Performance Criteria	Compensatory Measures
	Active	Passive	RSAC	MACCS2	SC	SS	Defense In-depth				
Fuel handling cave/fuel storage area fuel handling accident	None credited	None credited	100 m = 1.6E-02 13.7 km = 1.0E-03 LPF = 1.0	100 m = 5.45E+00 13.7 km = 8.97E-04 LPF = 1.0	None Required	None Required	None Required	Not Applicable (NA)	NA	NA	NA
Uranium hydride pyrophoric reaction	None Credited	Non credited	100 m = 1.3E-01 13.7 km = 3.0E-03 LPF = 1.0	100 m = 5.11E-01 13.7 km = 8.37E-05 LPF = 1.0	None Required	None Required	None Required	NA	NA	NA	NA
Inadvertent nuclear criticality in the fuel handling cave/fuel storage area (3 ATR baskets)	None credited	None credited	100 m = 6.2E+00 13.7 km = 2.2E-02 LPF = 1.0	100 m = 5.55E-01 13.7 km = 1.36E-04 LPF = 1.0	None Required	None Required	None Required	NA	NA	NA	NA
Fuel handling cave/fuel storage area structural failure	None credited	None credited	100 m = 8.8E+00 13.7 km = 1.7E-01 LP F= 1.0	100 m = 1.56E+00 13.7 km = 2.74E-04 LPF = 1.0	None Required	None Required	None Required	NA	N/A	NA	NA
Cask handling accident in cask receiving area	None credited	None credited	100 m = 4.3E+02 13.7 km = 1.9E-01 LPF = 1.0	100 m = 2.25E+01 13.7 km = 1.30E-02 LPF = 1.0	None Required	None Required	None Required	NA	NA	NA	NA
Fuel conditioning station overheating	None credited	None credited	100 m = 7.5E+00 13.7 km = 2.2E+01 LPF = 1.0	Not modeled	None Required	None Required	None Required	NA	NA	NA	NA

ATR — Advanced Test Reactor
LPF — leak path factor
NA — not applicable
MACCS2 — MELCOR Accident Consequence Code System 2
RSAC — Radiological Safety Analysis Computer
SC — safety class
SS — safety significant

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 Table (Table 5.1)

VENTILATION SYSTEM COMPARISONS 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 by accident analysis to control hazardous material release; demonstrate by use considering potential in-leakage.	The hazard and accident analysis in the DSA do 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-114 Rev. 10, "Safety Analysis Report for the Irradiated Fuel Storage Facility (IFSF)," 08/17/06 TFR-176 Rev. 1, "INTEC-603 Irradiated Fuel Storage Facility Ventilation System Upgrade" Section 3.1.1.2
Materials of construction should be appropriate for normal, abnormal and accident conditions	None.	To the extent possible, the system is constructed of fire-resistant materials. A fire protection screen F-SFE-123 is installed upstream of the HEPA filters to prevent ignition of the HEPA filters by burning embers. Pre-filters in the supply and HEPA filter housings are UL Class I.	TFR-176
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 system is not credited in any accident scenario. The accident analysis in the DSA does not credit the exhaust systems capabilities of withstanding abnormal and accident system conditions to maintain integrity.	SAR-114 Rev. 10, "Safety Analysis Report for the Irradiated Fuel Storage Facility (IFSF)," 08/17/06
CVSs 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.	System operability tests against the following requirements of the CVS demonstrate that the criteria are met: 1. The CVS provide HEPA filtration of all ventilation system air exhaust from the storage area and fuel handling cave, and crane maintenance area during facility operation. At least 2 HEPA filters are placed in series within exhaust ducts from areas defined as confinement zone I. Supply ducts to zone 1 confinement areas are also be provided with a high efficiency filter. 2. The supply duct filters shall have a removal efficiency of 90%. The air supplied to the IFSF shall be filtered to reduce noncontaminated airborne solids entry into the IFSF. The full-scale range of the supply flow is from 0 to 4,000 cfm. 2. The system shall be designed so control may prevent back-flow through parallel subsystems and through the supply duct. The system shall be designed to prevent the release of airborne contamination through the supply system in the event of the storage area or fuel handling cave pressure rising above atmospheric pressure or the ventilation system shuts down. This requirement shall be met by design. 3. The accident analysis takes no credit for decontamination factors.	TFR-176, Section 3.1.1.3 TFR-176, Section 3.1.1.12 TFR-176, Section 3.1.1.10 Verified by S. O. test TPR-7405 SAR-114 Rev. 10 Section 3.4

<table>
<tr><th colspan="4">VENTILATION SYSTEM COMPARISONS TO PERFORMANCE CRITERIA</th></tr>
<tr><th>EVALUATION CRITERIA</th><th>CRITERIA EXPLANATION</th><th>COMPARISON TO CRITERIA</th><th>REFERENCE</th></tr>
<tr><th colspan="4">Ventilation System – Instrumentation and Control</th></tr>
<tr><td>Provide system status instrumentation and/or alarms</td><td>Address key information to ensure system operability (e.g., system delta-P, filter pressure drop).</td><td>System operability tests against the following requirements of the CVS demonstrate that the criteria are met:

A GUI shall be provided on the operator work station of the INTEC 603 Distributed Control System (DCS SYS IFSF). The GUI shall graphically display the ventilation system component status and instrument values, operate the system (automatically and allow overrides), and notify Operations staff of conditions that require attention.

The system shall be provided with the following instrumentation:
• Gauge pressure within the fuel handling cave and fuel storage area.
• Pressure drop across all HEPA filters, roughing filters, and pre-filters in supply and exhaust systems.
• Airflow in all exhaust and supply (both operating and parallel) systems. Flow instruments shall be provided with local read-outs.
• Temperature of supply and exhaust air.
• Motor vibrations in all blowers. Instruments should output axial vibration state to the FDCS.
• “Open” and “closed” transmitters on all automatic flow control dampers.
• Current indicating transmitters on all blowers.
• Stack-shrouded probe monitor. The stack-shrouded probe monitor shall be provided with sufficient instrumentation to ensure it is operating properly.
• Instruments shall interface to the CPP-603 Distributed Control System (DCS-SYS-IFSF) to allow monitoring, trending, and control.
• All manually operated dampers shall be provided with position-indicating marks on the damper arm.
• Instruments shall be provided with standby power.</td><td>SDD-57, “INTEC Fuel Storage Area Distributed Control Requirements.”

TFR-176, Section 3.3.4.2

S. O. test TPR-7405</td></tr>
</table>

VENTILATION SYSTEM COMPARISONS TO PERFORMANCE CRITERIA			
EVALUATION CRITERIA	CRITERIA EXPLANATION	COMPARISON TO CRITERIA	REFERENCE
Interlock supply and exhaust fans to prevent positive pressure differential	None.	The criteria are met because the supply and exhaust blowers are interlocked through the DCS. The DCS computer controls the ventilation system interlocks and fan startup. IFSF Start up procedure. An exhaust blower must be started prior to starting a supply blower and its output must exceed the input airflow of the supply blower. (This precaution is to prevent the potential spread of contamination from the fuel storage area due to pressurization.) Select AUTO mode, on the IFSF ventilation exhaust screen at OWS-GSF-901-5. Click on icon of exhaust blower to be started, on the IFSF ventilation exhaust screen at OWS-GSF-901-5. Select the START mode. Ensure the following happened for exhaust blower to be started, on the OWS-GSF-901-5 display: • The exhaust blower outlet damper opened • The two HEPA filter housing dampers associated with the exhaust blower opened • The exhaust blower started • Both supply dampers ACD-SFE-722 and ACD-SFE-723 opened. Monitor PD-SFE-100 for approximately one minute to ensure the fuel storage area pressure stabilizes at approximately -0.3 in. of water. <u>IF</u> a supply blower needs to be started, <u>THEN</u> start one supply blower as follows: • Ensure an exhaust blower is operating. • Ensure PD-SFE-100 remains relatively stable at -0.3 inches of water column. *SC-SFE-222/223 controls the speed for both supply blowers. Although, only one supply blower will operate at a time in AUTO mode.* Set supply blower to be started (see table below) speed controller SC-SFE-222/223 to 25% from the IFSF. Click on icon of supply blower being started. Select START mode. Ensure the following happened for supply blower being started, on the OWS-GSF-901-5 display: • The outlet damper for the supply blower being operated remained opened • The supply blower started • The other supply blower damper closed.	TFR-260 and CSCF-261 TPR-7484

VENTILATION SYSTEM COMPARISONS TO PERFORMANCE CRITERIA			
EVALUATION CRITERIA	**CRITERIA EXPLANATION**	**COMPARISON TO CRITERIA**	**REFERENCE**
		This step-by-step sequence ensures that the exhaust starts first; dampers are correctly positioned; and IF the supplies are requested, they start last. The sequence precludes the system from positively pressurizing the IFSF storage area.	
Post accident indication of filter break-through	Instrumentation supports post accident planning and response: should be considered critical instrumentation for safety class.	The system meets the requirements as identified in the following technical and functional requirements: Design shall include an isokinetic stack monitor. Monitor design shall meet the requirements of ANSI N13.1-1999 "Sampling Airborne Radioactive Materials in Nuclear Facilities." The system monitors pressure drop across all HEPA filters, roughing filters, and pre-filters in supply and exhaust systems.	TFR-176, Section 3.7.6.1
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.	TFR-176 SAR-114
Control components should fail safe	None.	The system meets the requirements. All rotating equipment is metal enclosed and the system has software interlocks to prevent positive pressurizations. Upon loss of power the equipment shuts down to a fail safe state. The equipment is powered with backup power and will not restart without operator action.	TFR-260, CSCF-261, TFR-176, Drawings 623817 through 623905
Resistance to Internal Events - Fire			
CVSs 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 IFSF is not a new facility. The ventilation system is not credited for any scenario in the hazard or accident analysis sections. To the extent possible, the system is constructed of fire-resistant materials. A fire protection screen F-SFE-123 is installed upstream of the HEPA filters to prevent ignition of the HEPA filters by burning embers. Pre-filters in the supply and HEPA filter housings are UL Class I.	TFR-176
CVSs 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 IFSF is not a new facility. The ventilation system is not credited for any scenario in the hazard or accident analysis sections. It is not credited for preventing the propagation of a fire.	TFR-176

VENTILATION SYSTEM COMPARISONS TO PERFORMANCE CRITERIA			
EVALUATION CRITERIA	**CRITERIA EXPLANATION**	**COMPARISON TO CRITERIA**	**REFERENCE**
Resistance to External Events – Natural Phenomena – Seismic			
Confinement ventilation systems should safely withstand earthquakes	If the active CVS is not credited in a seismic accident condition, there is no need to evaluate that performance and/or design attribute for the CVS (discretionary). Also, any seismic impact on the CVS 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 not credited for any scenario in the hazard or accident analysis sections. It is not credited in a seismic accident. The system performance category shall therefore be defined to be PC-2, which is consistent with 'providing emergency functions' in DOE STD 1021-93. The enclosure and structure of the IFSF system will be categorized as PC-1. The categorization is consistent with the enclosure and structure safety category of consumer grade as specified in TFR-176 Section 2.1.6.	TFR-176 Section 3.2.4.2
Resistance to External Events – Natural Phenomena – Tornado/Wind			
CVS should safely withstand tornado depressurization	If the active CVS is not credited in a tornado condition, there is no need to evaluate that performance and/or design attribute for the confinement ventilation system (discretionary). Also, any tornado impact on the confinement ventilation system performance will be based on the current functional requirement in the DSA.	The ventilation system is not credited for any scenario in the hazard or accident analysis sections. It is not credited in a tornado condition. DOE Standard DOE-STD-1020-2002 does not identify tornado criteria for the INL.	SAR-114
CVS should withstand design wind effects on system performance	If the active CVS is not credited in a wind condition, there is no need to evaluate that performance and/or design attribute for the CVS (discretionary). Also, any wind impact on the CVS performance will be based on the current NP analysis in the DSA.	The ventilation system is not credited for any scenario in the hazard or accident analysis sections. It is not credited in a wind condition. The system is designed for wind speeds up to 100 mph. The wind is assumed to be dust laden.	SAR-114 TFR-176 Section 3.2.4.1

VENTILATION SYSTEM COMPARISONS TO PERFORMANCE CRITERIA			
EVALUATION CRITERIA	**CRITERIA EXPLANATION**	**COMPARISON TO CRITERIA**	**REFERENCE**
Other NP Events (e.g., flooding, precipitation)			
CVS should withstand other NP events considered credible in the DSA where the confinement ventilation system is credited	If the active CVS is not credited for this event, there is no need to evaluate that performance and/or design attribute for the CVS (discretionary). Also, any impact on the confinement ventilation system performance will be based on the current NP analysis in the DSA.	The ventilation system is not credited for any scenario in the hazard or accident analysis sections. It is not credited in any NP condition.	SAR-114
Range Fires/Dust Storms			
Administrative controls should be established to protect CVSs from barrier-threatening events	Ensure that a properly thought out response to external threat is defined (e.g., prefire 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, and procedures and fire hazards analyses are performed and for maintaining approved emergency response procedures.	TSR-114, "Technical Safety Requirements for the Irradiated Fuel Storage Facility (IFSF)" TSR-100, "ICP Standardized Technical Safety Requirements (TSR) Document"
Testability			
Design supports the periodic inspection and testing of filters and housing; and 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 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"
Instrumentation required to support system operability is calibrated	Credited instrumentation should have specified calibration/surveillance requirements. Nonsafety instrumentation should be calibrated as necessary to support system functionality.	The DSA for the IFSF does not credit ventilation system instrumentation in any accident scenario. Instrument calibration is governed by MCP-1292, INTEC Administration of *Instrument Calibrations*.	SAR-114 MCP-1292, INTEC Administration of Instrument Calibrations (Supplement to MCP 6303).

VENTILATION SYSTEM COMPARISONS TO PERFORMANCE CRITERIA			
EVALUATION CRITERIA	**CRITERIA EXPLANATION**	**COMPARISON TO CRITERIA**	**REFERENCE**
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 IFSF HVAC systems are specified in procedures. Periodic testing of blowers is also specified in procedure. The accident analysis in the DSA does not identify required responses for the ventilation system.	SAR-114 TPR-7405 "IFSF HVAC Upgrade SO Test" TPR-7484 "Operation of the IFSF Ventilation and Stack Monitoring Systems (CPP-2710)"
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) IFSF Filter components are specified in procedure. Filters are replaced if in-place testing indicates filter damage or leakage.	TPR-7146, "Replace Off-Gas Filter Components" TPR-5054, "HEPA Filter in Place Testing"
Single Failure			
Failure of one component (equipment or control) shall not affect continuous operation	Criteria do not apply to safety-significant systems.	Redundant supply and exhaust fans are provided but not required by the DSA.	SAR-114 SO test TPR-7405
Automatic backup electrical power shall be provided to all critical instruments and equipment required to operate and monitor the CVS	Criteria do 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 CVS	None.	The design requirements show that the system meets the criteria. Exhaust blowers, all system electrical components, and instruments required to operate the exhaust system shall be provided with standby power.	TFR-176 Section 3.3.3.3
Other Credited Functional Requirements			
Address any specific functional requirements for the CVS (beyond the scope of those above) credited in the DSA	None.	Not applicable.	Not applicable

IFSF CONFINEMENT VENTILATION SYSTEM EVALUATION

VENTILATION SYSTEM COMPARISONS TO PERFORMANCE CRITERIA			
EVALUATION CRITERIA	CRITERIA EXPLANATION	COMPARISON TO CRITERIA	REFERENCE

ANSI	American National Standards Institute
CSCF	Computer System Change Form
CVS	confinement ventilation system
DCS	Distributed Control System
DSA	documented safety analysis
FDCS	Fuel Storage Area Distributed Control System
GUI	graphic use interface
HEPA	high-efficiency particulate air
ICP	Idaho Cleanup Project
IFSF	Irradiated Fuel Storage Facility
INTEC	Idaho Nuclear Technology and Engineering Center
NP	natural phenomena
PC	performance criteria
SAR	Safety Analysis Report
SO	system operability
SSC	structure, system, and component
TFR	technical and functional requirement
UL	Underwriters Laboratory, Inc.