

**Office of Enterprise Assessments Targeted Review of the
Idaho National Laboratory Fire Protection Program as
Implemented at the Irradiated Materials Characterization
Laboratory at the Idaho Site**



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**Office of Environment, Safety and Health Assessments
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Acronyms

AHJ	Authority Having Jurisdiction
AMWTP	Advanced Mixed Waste Treatment Project
BEA	Battelle Energy Alliance, LLC
BNA	Baseline Needs Assessment
BTU	British Thermal Unit
CFR	Code of Federal Regulations
CRAD	Criteria, Review, and Approach Documents
DOE	U.S. Department of Energy
DOE-ID	DOE Idaho Operations Office
DSA	Documented Safety Analysis
EA	Office of Enterprise Assessments
EM	Office of Environmental Management
EMS	Emergency Medical Services
FHA	Fire Hazard Analysis
FM	Fire Marshall
FPE	Fire Protection Engineer
FPP	Fire Protection Program
gpm	Gallons Per Minute
HAZMAT	Hazardous Materials
HSS	Office of Health, Safety and Security
IBC	International Building Code
ICP	Idaho Cleanup Project
IMCL	Irradiated Materials Characterization Laboratory
INL	Idaho National Laboratory
ITM	Inspection, Testing, and Maintenance
LSS	Life Safety Systems
MFC	Materials and Fuels Complex
MPFL	Maximum Possible Fire Loss
NE	Office of Nuclear Energy
OFI	Opportunity for Improvement
R&D	Research and Development
TREAT	Transient Reactor Test Facility
TSR	Technical Safety Requirement

**Independent Oversight Review of the
Idaho National Laboratory Fire Protection Program as
Implemented at the Irradiated Materials Characterization
Laboratory at the Idaho Site**

EXECUTIVE SUMMARY

The Office of Nuclear Safety and Environmental Assessments within the U.S. Department of Energy, independent Office of Enterprise Assessments (EA), Office of Environment, Safety, and Health Assessments, conducted an independent review of the Idaho National Laboratory (INL) fire protection program (FPP) as implemented at the Irradiated Materials Characterization Laboratory (IMCL) at the Idaho Site. This review was one part of a targeted assessment of fire protection at nuclear facilities across the DOE complex. The IMCL facility is a prototype isolable laboratory facility to be used for informing DOE decisions about future post-irradiation examination needs to support crucial research and analysis of potential new reactor materials and fuels.

Fire protection was identified as an Independent Oversight targeted review area for 2013 in an HSS memorandum from the Chief Health, Safety and Security Officer to DOE senior line management, entitled *Independent Oversight of Nuclear Safety – Targeted Review Areas Starting in FY 2013*, dated November 6, 2012. Pursuant to this memorandum, EA reviewed and assessed the effectiveness of the INL FPP, with specific attention to program implementation at the IMCL facility, which is part of INL's Materials and Fuels Complex (MFC). The review included evaluation of key FPP elements, including the baseline needs assessments (BNAs), fire pre-plans, exemption and equivalency process, combustible control, fire hazard analysis (FHA), and the National Fire Protection Association (NFPA) inspection, testing, and maintenance (ITM) program. The assessment also evaluated FHA/documented safety analysis (DSA) integration and technical safety requirement (TSR) surveillance and testing for the IMCL facility, which is supported by various structures, systems, and components (SSCs) that are maintained as part of INL Material and Fuels Complex (MFC).

The INL Fire Protection Program, as implemented for the IMCL facility, is functional but needs significant improvement. The fire protection systems designed for the IMCL facility appear to be adequate and well-maintained, and the appropriate INL and DOE staff members appear to have a good understanding of how IMCL fire protection systems and MFC support systems function to protect the IMCL facility. However, considerable weaknesses were seen in the FPP and its implementation in support of the IMCL facility. It was observed that IMCL is reliant on an aging and degraded water supply infrastructure, which is susceptible to potential failures, and which may be challenged under certain stresses (e.g., worst-case fire scenario). It was also observed that, in many cases, program documentation was not properly followed, updated, or implemented. In part, these weaknesses may stem from the observed challenges that the contractor staff have in understanding group and individual roles and responsibilities. The Findings and opportunities for improvement presented in this report should help address the weaknesses that were observed.

Independent Oversight Targeted Review of the Idaho National Laboratory Fire Protection Program as Implemented at the Irradiated Materials Characterization Laboratory at the Idaho Site

1.0 PURPOSE

The U.S. Department of Energy (DOE) independent Office of Enterprise Assessments (EA) was established in May 2014 and assumed responsibility for managing the Department's Independent Oversight Program for the Department's former Office of Health, Safety and Security (HSS). The office now called the EA Office of Environment, Safety and Health Assessments conducted an independent review of the Idaho National Laboratory (INL) fire protection program (FPP) as implemented at the Irradiated Materials Characterization Laboratory (IMCL) at the Idaho Site. The review was one part of a targeted assessment of fire protection at nuclear facilities across the DOE complex.

The purpose of the EA targeted assessment was to evaluate implementation of program requirements that are intended to ensure that adequate controls have been implemented to reduce the risk resulting from a fire or explosion at nuclear facilities. Existing EA criteria, review, and approach documents (CRADs) were adapted to establish a focused set of inspection criteria, activities, and lines of inquiry for the targeted assessment. The independent review of IMCL is designed to evaluate the core fire protection elements and provide the site and responsible DOE Office of Nuclear Energy (NE) line management organizations with information for benchmarking their programs' effectiveness.

This independent review of the IMCL facility was performed at the Idaho Site from April 28 to May 2, 2014. This report discusses the scope, background, methodology, results, and conclusions of the review, as well as findings and opportunities for improvement (OFIs) identified during the review.

2.0 SCOPE

The Independent Oversight program is one element of DOE's multi-faceted approach to oversight, as described in DOE Policy 226.1, *Department of Energy Oversight Policy*. Effective oversight of DOE Federal and contractor operations is an integral part of DOE's responsibility as a self-regulating agency to provide assurance of its safety and security posture to its leadership, its workers, and the public. The Independent Oversight program is designed to enhance DOE safety and security programs by providing DOE and contractor managers, Congress, and other stakeholders with an independent assessment of the adequacy of DOE policy and requirements and the effectiveness of DOE and contractor line management performance in safety, security, and other critical functions as directed by the Secretary. DOE Order (O) 227.1, *Independent Oversight Program*, defines this program, which EA is responsible for implementing.

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EA reviewed and assessed the effectiveness of the INL FPP, with specific attention to program implementation at the IMCL facility, which is part of INL's Materials and Fuels Complex (MFC). The review included evaluation of key FPP elements, including the baseline needs assessments (BNAs), fire pre-plans, exemption and equivalency process, combustible control, fire hazard analysis (FHA), and the National Fire Protection Association (NFPA) inspection, testing, and maintenance (ITM) program. The assessment also evaluated FHA/documented safety analysis (DSA) integration and technical safety

requirement (TSR) surveillance and testing for the IMCL facility, which is supported by various structures, systems, and components (SSCs) that are maintained as part of MFC. At the time of this assessment, some aspects of the FPP and ITM had not been implemented at the IMCL since this facility was not yet operational.

3.0 BACKGROUND

The Idaho Site includes INL, the Idaho Cleanup Project (ICP), and the Advanced Mixed Waste Treatment Project (AMWTP). The DOE Idaho Operations Office (DOE-ID) provides direction and oversight for the design and operation of the Idaho Site nuclear facilities for NE and the DOE Office of Environmental Management (EM). NE is responsible for INL facilities and general site operations, and EM is responsible for ICP and AMWTP facilities. Within DOE-ID, two line management organizations are responsible for oversight of these nuclear facilities and their activities. The Deputy Manager for Operations Support is ultimately responsible for contractor oversight of the NE facilities, and under the Deputy Manager for ICP, oversight of the EM facilities is the responsibility of the Assistant Manager for Nuclear Safety and Performance. Currently, Battelle Energy Alliance, LLC (BEA); CH2M-WG Idaho, LLC (CWI); and Idaho Treatment Group, LLC are the primary contractors responsible for the management and operation of INL, ICP, and AMWTP facilities, respectively.

The MFC comprises multiple facilities used to conduct research and development (R&D) activities. These R&D activities focus on topics of national concern relating to energy, nuclear safety, spent nuclear fuel, environmental restoration, proliferation, decommissioning and decontamination technologies, and national security. The recently completed IMCL facility of the INL Material and Fuels Complex (MFC) supports crucial research and analysis of potential new reactor materials and fuels. IMCL is a prototype isolable laboratory facility to be used for informing DOE decisions about future post-irradiation examination needs with regard to construction, safety, and performance.

4.0 METHODOLOGY

The EA review of the INL FPP as implemented at IMCL included document reviews and facility walkdowns. The review considered the requirements of 10 CFR 851, *Worker Safety and Health Program*; DOE Order 420.1B, *Facility Safety*; and NFPA codes and standards.

The FPP was assessed using the objectives and criteria identified below. The criteria were based on program elements from DOE O 420.1B and DOE O 226.1B and were grouped together by similarity under an overall objective.

The following sections of HSS CRAD 45-34, Revision 1, were used for the targeted assessment:

- Section I, Programmatic Elements, FP-1, Program Documentation
- Section I, Programmatic Elements, FP-2, Program Implementation - Fire and Related Safety Hazards
- Section I, Programmatic Elements, FP-3, Program Implementation - Fire Prevention and Protection
- Section II, FHA/DSA Integration, FP-4
- Section IV, TSR Surveillance Testing.

5.0 RESULTS

5.1 Program Documentation

This portion of the review was to determine whether the following inspection criteria were satisfied:

- *A documented fire safety program exists as required by applicable safety criteria. (DOE Order 420.1B, DOE-STD-1066-99)*
- *A baseline needs assessment (BNA) of the fire protection emergency response organization has been documented and updated every 3 years. The plan should describe in sufficient detail fire-fighting operations for the respective facilities. (10 CFR 851, DOE Order 420.1B, DOE-STD-1066-99)*
- *Processes are developed and implemented that prioritizes and monitors the status of fire protection assessment findings, recommendations, and corrective actions until final resolution. [DOE Order 420.1B, Contractor Requirements Document, Chapter II, 3.b(15)]*
- *Program issues identified during previous assessments or program reviews have been appropriately resolved, corrective actions have been completed, and are adequate, or a clear path to completion is indicated. [DOE Order 226.1B]*

INL Fire Protection Program as Implemented at IMCL

The IMCL at MFC has a documented fire safety program as described in procedure LRD-14401, *INL Fire Protection Program*. The FPP is intended to ensure compliance with applicable fire protection requirements and establishes a level of fire protection sufficient to achieve the programmatic requirements outlined in DOE O 420.1B, *Facility Safety*. The FPP also implements the fire protection and emergency services criteria necessary to comply with 10 CFR 851, *Worker Safety and Health Program*. Roles and responsibilities for the BEA Occupational Safety and Health Division are described in procedure LRD-14002, *Safety, Fire Protection, and Industrial Hygiene Functions, Roles, Responsibilities, and Interfaces*. This document briefly describes the role of the INL Fire Marshall (FM) and deployed Fire Protection Engineers (FPEs).

The INL FM has the overall responsibility for maintaining an effective program to support the DOE-ID Authority Having Jurisdiction (AHJ). The INL FPP is based on nationally recognized codes and standards, including the IBC, NFPA, and applicable orders relating to fire prevention. The requirements apply to fire protection at all facilities operated by the prime contractor at INL. The INL FPP includes written safety procedures and implementing documents to reduce the risk and consequence of incidents involving fires. The FM is responsible for maintaining an adequate staff of qualified and trained FPEs necessary for the implementation of the fire program. Enforcement and compliance are achieved through reviews and approval by the FM for new and significant changes to facilities that present complex challenges.

The FPEs were responsible for developing and approving facility FHA and fire safety assessments. The IMCL FPE is deployed from the contractor and works directly for the facility to help implement the FPP and support the development of administrative fire procedures and engineering support.

INL FPP procedure LRD-14401, *INL Fire Protection Program*, has shortcomings in that it does not describe the key elements of the FPP and how they are implemented at the facility level, and this document has not been updated since 2009. Chapter II, Section 3.b.(2) of DOE O 420.1B, *Facility Safety*, requires that the contractor develop, implement, and maintain comprehensive written procedures identifying the Fire Protection Program organization and respective responsibilities. These shortcomings in the INL documentation of how the FPP is organized and how the roles and responsibilities are defined

were evident during EA's onsite interviews. At a minimum, it was evident that implementation of program documentation that describes roles and responsibilities, as required by the Order, was incomplete. For example, the Life Safety Systems (LSS) representative did not understand their interface with facility engineering, and there was confusion between the system engineer's role and that of the FPE. In addition, ITM involved multiple work groups whose roles and responsibilities were not clearly defined; most of the work was being completed by LSS, but the utility engineers performed fire pump testing and maintenance on the hydrants and post indicator valves (PIV). Finally, the IMCL system engineer could not explain who the design authority was for the fire protection systems. The limited understanding of individual roles and responsibilities could contribute to some of the additional weaknesses and areas needing improvement that were observed during this assessment, as described in this report. (See **Finding IMCL-F-01.**)

The Fire Department is an integral part of the Emergency Services Department and provides on-scene emergency response operations for the INL Emergency Management System. The integration of emergency services functions includes program development, implementation, and emergency response to support a unified response to all emergencies. Procedure PDD-118, *Fire Department*, outlines the process for meeting the emergency services requirements, which involve emergency medical services (EMS) operation, structural fire suppression, hazardous materials (HAZMAT) mitigation, technical rescue, wildland firefighting, IPSS operation, fire and emergency medical dispatch, and associated support functions for the entire site. Guidance for establishing the Fire Department organizational structure is taken from NFPA-1201, *Standard for Providing Emergency Services to the Public*.

Fire Impairments

INL procedure LWP-14407, *Managing Fire Protection Impairments Procedure*, provides the minimum requirements for controlling fire protection system impairments and ensuring that systems are returned to service in an acceptable and timely manner. The procedure provides time allowances for repair and restoration, including the minimum duration for the impairment unless an extension is approved by the FPE. However, only active systems are currently being managed using this impairment procedure; passive systems, including fire barriers, are not managed by the procedure, and therefore, impairments with important fire protection systems are not systematically evaluated and addressed. DOE O 420.1B, *Facility Safety*, explicitly requires that comprehensive, written, fire protection criteria or procedures on fire protection system impairments be included in an acceptable fire protection program, and does not limit impairments to active fire systems. The applicability of this requirement to both active and passive fire systems is further evidenced by the DOE O 420.1B, Chapter II, Section 3.b.(15), requirement that fire protection programs have a process to prioritize and monitor the status of fire protection assessment findings, recommendations, and corrective actions until final resolution. Assessment findings are written on both active and passive systems, so these two classifications of fire systems are not to be treated differently in accordance with this requirement. Therefore, methods must be in place to manage impairments to both active and passive fire systems (e.g., fire barriers being credited as fire walls), as both types of systems are of equal importance to safety. In addition, the approved LWP-14407 definition of Fire Protection System Impairment does not distinguish between active or passive systems, and there is no indication that an exemption to this requirement has been sought from or granted from DOE.

The following examples (Ref. Periodic Fire Safety Assessment for MFC, Integrated Assessment System No. 132149) were identified by BEA as deficiencies but not tracked for evaluation or documented as impairments: (See **Finding IMCL-F-01.**)

- MFC-706 - The wall separating the north and south sides of the buildings were credited for 2-hr fire resistive construction; however, the wall was built incorrectly leaving gaps in the wall joint and roof trusses between the north and south spaces.

- MFC-774 - A 1-hr fire rated barrier was not provided to separate the diesel generator and day tank from the rest of the basement.
- MFC-798 - The walls of the electrical equipment room No. 103, which house the standby 25 KW diesel generator and fuel tank, were not credited as a 1-hr fire resistance barrier, and maintained per LRD-14403.

Exemption and Equivalency Process

INL has developed and implemented a process for reviewing and recommending approval to DOE of fire safety equivalencies and exemptions from requirements found in DOE orders, fire protection codes, or standards in accordance with DOE O 420.1B, Contractor Requirements Document, Chapter II, 3.b(16). The procedure, LRD-14402, *INL Fire Protection Authority Having Jurisdiction Program*, outlines the process for preparing, reviewing, and submitting equivalency and exemption requests for approval. The FM review and concurrence is required prior to submittal to DOE-ID for final approval.

The BNA, INL/INT-10-12550, *INL Fire Department Emergency Response Baseline Needs Assessment*, identified several areas of noncompliance with NFPA-1710 requirements, including travel time for deployment of an initial full alarm and EMS capability for first responders. These areas of noncompliance were justified within the BNA, on the basis of compensatory measures, but were not evaluated for either an equivalency or an exemption in accordance with procedure LWP-14402, *Fire Protection Authority Having Jurisdiction (AHJ) Records, Exemptions and Equivalencies* (see **Finding IMCL-F-01**). In addition, compensatory measures were not evaluated for effectiveness as implemented.

As required by DOE O 420.1B, *Facility Safety*, and the INL Fire Protection procedure, MCP-14401, *Fire Hazard Analysis*, BNA conclusions must be incorporated into the respective facility's FHA. However, the areas of noncompliance that the BNA identified were not documented in the IMCL FHA. (See **Finding IMCL-F-01**.)

Baseline Needs Assessment

DOE Order 420.1B requires that each site establish its capabilities to provide timely and effective firefighting response with sufficient staffing, apparatus, facilities, and equipment. These capabilities are to be documented in a BNA that reflects applicable NFPA codes and standards and updated every three years. Responsive to this requirement, the INL Fire Department has prepared and maintains a BNA that is based on requirements established in NFPA-1710 but also considers other NFPA codes and standards, as well as other requirements and guidance documents that address emergency response, customized to meet INL's unique requirements. The INL Fire Department provides EMS, structural fire suppression, hazardous material mitigation, technical rescue, wildfire firefighting, and INL supervising station operation.

The BNA reflects the tri-annual review of the Fire Department and is based on the guidance of DOE Guide 420.1-3 and criteria of NFPA-1710, *Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Emergency Services Requirements*. The BNA identifies credible fires for MFC, including fires involving radiological material, HAZMAT, spill of radiological material, structural fire, wildland urban interface fire, operational accident (including confined space and high angle rescue), construction or D&D accident and criticality accident. Fully deployed, the INL Fire Department can mobilize four engine companies with a total of at least 22 personnel from the three fire stations.

The INL Fire Department has developed an updated draft BNA that was scheduled to be approved and issued by June 2014. The draft document adequately addresses the minimum Fire Department staffing,

apparatus, equipment, and procedures. The approved BNA was issued in March 2011 and, at the time of this assessment, had not been updated to meet the tri-annual frequency required by DOE Order 420.1B; however, on October 27, 2014, the updated INL BNA was approved by the AHJ.

Pre-Incident Plans

The IMCL Pre-Incident plan, MFC 1729, *Irradiated Materials Characterization Laboratory*, identifies most of the fire and exposure risks at the facility. Overall, the plan meets the requirement to communicate pertinent information in a short period of time for the responding INL Fire Department Station #2. However, some key items were not documented in the plan. For example: (See **OFI-IMCL-02.**)

- The facility description identifies two distinct fire areas, but the building drawing does not show the fire wall that separates these two areas [the operating (laboratory) wing and the IMCL support wing].
- The section on special conditions indicates a potential for radiation and contamination, but the plan describes no controls for potential water runoff through the exterior doors of the building.
- The building drawing shows compressed gas bottles but does not identify the type of gas.

Control of Combustibles

DOE O 420.1B requires that an FPP include comprehensive, written fire protection criteria or procedures that address controls on the use and storage of combustible, flammable, radioactive, and hazardous materials to minimize risk from fire. DOE STD 1066 reinforces this DOE O 420.1B requirement, stating that a combustible control program is a required element of all FPPs and requiring a documented description of general housekeeping practices, control of transient combustibles, and control of flammable and combustible liquids and gases. DOE Guide 420.1-3 further states that the quantity and associated hazards of flammable and combustible materials that are often found within the fire area should be factored into FHAs. In addition, NFPA-801 requires the fire protection plan to establish administrative controls governing general fire prevention activities, such as control of combustibles and ignition sources. The expected quantity and associated hazards of flammable and combustible materials within the fire area should also be factored into the hazard analyses and considered when selecting fire accident control strategies, and the presence of transient combustibles associated with storage and maintenance activities should be considered. Where a facility is fully protected, as required by fire codes and standards, combustibles may be limited and controlled through normal housekeeping programs.

The combustible loading program procedure, LWP-14404, *INL Combustible Loading Program*, establishes guidelines for minimizing transient combustibles to reduce the risk associated with fires. The procedure requires the FPE to institute specific controls that support the operational requirements identified in the FHA and DSA. The IMCL FPE has developed a specific combustible loading procedure, SD-47.1.3, *IMCL Combustible Loading Program*, for managing transient combustibles that includes directs annual facility walkthroughs to assess the adequacy and implementation of the combustible loading program. The procedure defines Combustible Loading Classifications based on quantities of combustibles, ranging from a low classification equivalent to 100,000 British thermal unit (BTU)/ft² to a high classification of 800,000 BTU/ft². Other responsibilities for managing combustibles include those of the IMCL shift supervisor, who ensures completion of the Daily Surveillance Log, which evaluates combustible loading for each shift.

Future operations of IMCL will involve a dynamic environment in which each tenant will have different physical needs, resulting in a greater need to manage the risk associated with transient combustibles. For example, several operational scenarios will require specific limits on transient fuels in the shipping bay

and operating gallery, laboratory gloves, and other combustibles inside the modular shielded enclosures. The process for managing the combustible loading program is adequate, but EA observed that the FPE has not performed regular walkdowns (e.g., semi-annual or monthly, depending on the number of tenants in the building). (See **OFI-IMCL-03**.)

Issues Management – Corrective Actions

DOE O 420.1B, Attachment 2, *Contractor Requirements Document*, Chapter II, 3.b (15) requires “Processes to prioritize and monitor the status of fire protection assessment findings, recommendations, and corrective actions until final resolution.” Facility issues relating to fire protection are currently given a risk ranking of low, moderate, or high, based on feedback from the facility FPE. The issues are also evaluated in accordance with procedure LWP-13840, *Corrective Action System*, and then tracked in the LabWay system. This process does not evaluate risk in terms of fire protection or consider such critical factors as life safety, unacceptable program interruption, fire loss potential in excess of limits defined by DOE STD 1066-99, and potential damage to process control and safety systems. These and other risk factors can have a significant impact on the frequency and consequence of fire events. The DOE STD 1066-99 method of risk ranking is currently used at other DOE sites and would help identify the more serious deficiencies and promote prompt corrective actions and appropriate compensatory measures. (See **OFI-IMCL-04**.)

5.2 Fire and Related Safety Hazards Analyses

This portion of the review determined whether the following inspection criteria were satisfied:

- *Fire Hazard Analyses (FHA) have been prepared for each nuclear facility and the results coordinated and integrated into the Documented Safety Analysis as required. (DOE Order 420.1B, DOE STD-1066-99, DOE-HDBK-1163, NFPA-801)*
- *Fire and related safety hazards on site (or within the facility) have been identified and evaluated in conjunction with a current and comprehensive FHA. (DOE Order 420.1B)*
- *The FHA and self-assessments address all essential elements for a complete analysis as delineated in DOE Order 420.1 and its implementation guide. (DOE Order 420.1B and DOE Guide 420.1-3)*
- *The information contained in the FHA and assessment is accurate, as required by applicable fire safety criteria. (DOE Order 420.1B)*

The INL FPP provides for preparation of a detailed FHA to assess the risk of fire within individual fire areas through implementation of the INL fire hazard analysis procedure, MCP-14401, *Performing Fire Hazard Analysis*. This standard was used as the basis for developing the MFC Area FHA, HAD-432, Rev. 1, issued in February 2014, and the IMCL FHA, HAD-465, Rev. 1, issued in October 2013. These FHAs are required to comprehensively and qualitatively assess the risk from fire within individual fire areas to meet DOE Order 420.1B, *Facility Safety*, and are required for all Hazard Category 1, 2, and 3 nuclear facilities that store or process significant quantities of HAZMAT. The FHA is required to document, in part, a description of the facility building construction, important process equipment and operations, the fire hazards, and high value equipment. It is also required to document the Maximum Possible Fire Loss (MPFL) related to the worst-case design basis fire scenario. The content of the FHA is a primary source of input to the safety analysis for determination of fire hazards and available preventive and mitigative controls.

The IMCL has been evaluated to be a Hazard Category 2 facility, and the INL FPP document recognizes the FHA as the source document that establishes the design basis for the fire protection features of the facility.

The FHA for the IMCL, HAD-465, Rev. 1, describes the current occupancy type based on the IBC and NFPA-101, *Life Safety Code*. The IMCL FHA describes a portion of the building as the laboratory wing and references NFPA-45, *Standard on Fire Protection for Laboratories Using Chemicals*. SD-47.1.1, *Administrative Requirements Procedure*, for the IMCL states, “NFPA-45 is applicable for chemical storage in the operating (laboratory) wing.” However, the IMCL FHA does not classify the laboratory in accordance with NFPA-45, nor does it identify related requirements, including fire separation, limitations on flammable liquids, means of egress, and fire extinguishing systems. (See **Finding IMCL-F-02.**) A two-hour fire barrier separates the IMCL laboratory wing from the IMCL support wing, but the FHA does not provide a design basis for this passive system. Responsible staff indicated that this issue was identified in the operational readiness review (ORR) for the IMCL, and that the corrective action was a revision to the FHA, HAD-465. EA will follow up and review this FHA revision to verify that it resolves this Finding.

5.3 Fire Prevention and Protection SSCs and Controls

This portion of the review was intended to determine whether the following inspection criteria were satisfied:

- *A complete spectrum of fire prevention controls and procedures are in existence and have been implemented as required by applicable fire safety criteria. (DOE Order 420.1B, Site & Facility DSA)*
- *All fixed fire protection features (appropriate construction types, fire barriers, fire alarm and signaling systems, manual and automatic fire suppression systems, etc.), that are required by authorization basis documents and fire hazards analyses, have been installed and are tested and maintained, as required by applicable fire safety criteria. (DOE Order 420.1B, Site & Facility DSA)*

EA reviewed fire protection systems at the IMCL facility to determine whether an appropriate ITM program for fire protection features is in place and will be conducted. Fire protection systems and controls are not credited safety significant features but are classified as administrative controls. However, regardless of this classification, the requirements of NFPA-25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems*; NFPA-72, *National Fire Alarm Code*; and other applicable NFPA standards and code ITM requirements apply and have been incorporated into the INL FPP. The applicable administrative control criteria are the FPP and ITM program. A written, facility-specific IMCL combustible loading program is implemented that is intended to minimize the accumulation of combustible material and maintain the fire loading in the operating (laboratory) area at or below that described in the IMCL FHA. However, the FHA has not classified the IMCL facility consistent with SD-47.1.1, *IMCL Administrative Requirements Procedure*, which identifies NFPA-45 requirements as they apply to chemical storage in laboratories (see Section 5.2). Additionally, the maximum quantity of flammable and combustible liquids identified in SD-47.1.1 is not addressed in SD-47.1.3, *IMCL Combustible Loading Program*. (See **Finding IMCL-F-02.**)

Infrastructure Water Supply

The IMCL water supply was reviewed against the requirements of DOE O 420.1B, Attachment 2, Chapter II, Section 3.c.1, which requires that DOE facilities be provided with a reliable and adequate supply of water for fire suppression. The water supply system for the IMCL facility is a combined firewater and potable water service provided from the MFC infrastructure distribution grid. The MFC distribution system consists of deep-well pumps that provide makeup water to two water storage tanks (one tank is currently out of service), service water pumps, fire pumps, fire hydrants, control and sectional valves, and an underground piping distribution system. The fire and service water pumps receive their supply from this tank and supply water to the distribution system to meet the demand.

The water supply for the MFC water system as originally configured took fire and service water from two tanks: Tank MFC-754A, which has a capacity of 137,500 gallons and feeds the primary fire pump MFC-754; and Tank MFC-749, which has a total capacity of 400,000-gallons of which 375,360 gallons is usable. However, the smaller Tank MFC-754A failed an internal inspection and has been drained and taken out of service due to questionable integrity. Therefore, the larger 375,360 gallon Tank MFC-749 is the only storage tank in use. The valve lineup is such that this tank supplies the process water pumps, the 1,000 gallons per minute (gpm) diesel-engine-driven fire pump, and the 4,000 gpm diesel-engine-driven fire pump.

EA determined that documentation for the MFC water supply system, which supplies IMCL, does not explain how the system's current condition and configuration provides for an adequate and reliable water supply, as required by DOE O 420.1B. (See **OFI-IMCL-01**.) The following factors contribute to this concern:

- The primary fire water diesel pump MFC-754, rated at 1,000 gpm, has been derated from its design output to approximately 20% below the manufacture performance pump curve. No compensatory measures have been identified, and the system has not been designated as impaired. During annual pump tests, the pump has not been able to supply the rated demand. Records dating back to the early 1970s indicate that the pump has been performing in a lower-than-rated condition over that time period. Responsible staff has indicated that, since the EA review, this pump has been reclassified as an industrial pump, but is still classified as the primary fire pump in MFC Area FHA HAD-432.
- The firewater tank, MFC-754A, is currently impaired due to interior corrosion and has been taken out of service. Based on conclusions drawn and documented in MFC technical evaluation TEV-1587, Revision 0, the maximum potential fire loss (MPFL) at some MFC facilities exceeds 50 million dollars. Therefore, consistent with DOE STD 1066-99, redundant fire protection systems should be used, or a justified alternative is to be analyzed and demonstrated to meet the requirements of DOE O 420.1B, Chapter II, Section 3.(c).1. Although this requirement may not specifically apply to IMCL, compliant fire protection systems may not be available to other MFC facilities, given the absence of tank MFC-754A and the degraded primary water pump.
- No health and wellness assessment of the underground water distribution system has been performed to evaluate the condition of the piping, valves, and other system components to validate their performance and reliability. The current system is aged and constructed largely of cast iron piping, and several major breaks have occurred. There are no plans to proactively incrementally replace vulnerable aged piping.

MFC has recognized the inadequacy of the water supply for some time; this is a long standing issue that BEA is currently working to resolve with a new 400,000-gallon tank, pump, and firewater loop that includes the Transient Reactor Test Facility (TREAT).

5.4 FHA/DSA Integration

This portion of the review was intended to determine whether the following inspection criteria were satisfied:

- *Within the scope of the review, the FHA conclusions shall be incorporated into the safety authorization (preliminary safety design review, preliminary DSA, or DSA, as appropriate) and demonstrate the adequacy of controls provided by the system to eliminate, limit, or mitigate identified hazards, and define the process for maintaining the controls and controlling their use.*

- *The safety authorization basis is consistent with the fire hazards analysis; demonstrates the adequacy of controls provided by the system to eliminate, limit, or mitigate identified hazards; and defines the processes for maintaining the controls current at all times and controlling their use.*

In accordance with DOE O 420.1B, the conclusions of the FHA are to be incorporated in the DSA for Hazard Category 1, 2, or 3 nuclear facilities to provide consistency between fire accidents analyzed in the DSA and the actual fire hazards analyzed in the facility. EA reviewed the FHAs for the IMCL, HAD-465, Rev. 1, and for the MFC site area, HAD-432, Rev 1, for consistency with the facility's DSA to determine the adequacy of the selected fire protection control set, the identified hazards, and the combustible loading controls. The facility FHA comprehensively and qualitatively identifies the fire hazards and assesses the risk from fire within individual fire areas in the facility. A concise description of building construction is provided as required, and fire rated area separations are identified. However, some omissions, inconsistencies, and potential weaknesses were noted: (See **OFI-IMCL-05**.)

- For a fire involving a transport vehicle, the facility FHA assumes that 50 gallons of either gas or diesel fuel is involved with fires in the operating gallery or the shipping bay. Neither DSA Chapter 3 nor the combustible loading program procedure, SD-47.1.3, specifically addresses any limit on diesel fuel or gasoline for transport or forklift vehicles consistent with the FHA.
- The IMCL FHA does not identify means to contain potentially contaminated sprinkler water runoff as required by NFPA-801.
- There are no safety basis heat release rate analyses for the fuel spill accident scenarios. The methodology and empirical estimate are presented in the FHA, but without any independent formal analysis specific to IMCL.
- The IMCL FHA determination of MPFL does not consider the cost of lost time (as mission interruption costs) or costs for reestablishing operations.
- The MFC site area FHA does not adequately evaluate the firewater supply distribution system or describe many of the known deficiencies that affect system reliability. Only the deficiencies related to the water pipe mains supplying the TREAT reactor area are identified in the FHA as open issues.

5.5 TSR Surveillance Testing and ITM

This portion of the review was intended to determine whether the following inspection criteria were satisfied:

- *Surveillance and testing of the system demonstrates that the system is capable of accomplishing its safety functions and continues to meet applicable system requirements and performance criteria.*
- *Surveillance and test procedures confirm that key operating parameters for the overall system and its major components remain within safety basis, NFPA, and applicable consensus standards operating limits.*
- *The acceptance criteria from the surveillance tests used to confirm system operability are consistent with the safety basis.*
- *Instrumentation and test equipment for the system are calibrated and maintained.*

The LSS group ensures ITM for the fire systems at INL, including the needed and required modifications and the preventive and corrective maintenance for fire protection features in buildings, equipment, and systems, including fire detection and protection systems. The ITM of the fire alarm and suppression systems generally demonstrates that the systems are capable of accomplishing their functional

requirements and continue to meet applicable system performance criteria. ITM procedures confirm that key operating parameters for the overall fire suppression system and the fire alarm system (and their major components) remain compliant with NFPA-25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems*; NFPA-72, *National Fire Alarm Code*; and other applicable NFPA standards and codes. Tables A.1 through A.9 of LRD-14403, *Inspection Testing and Maintenance of Fire Protection Systems and Equipment Procedure*, state the required frequency requirements for ITM of fire protection systems and equipment.

The LSS procedure has been updated to reflect the revised NFPA-25 and 72 standard requirements. However, interviews with LSS management indicated that these requirements have not been communicated to the LSS group to ensure that their procedures are revised accordingly. (See **OFI-IMCL-06**.)

6.0 CONCLUSIONS

EA concludes that the INL Fire Protection Program, as implemented for the IMCL facility, is functional but can and should be greatly improved by resolving the documented Findings and considering the OFIs discussed in Sections 7.0 and 8.0 of this report.

The fire protection systems designed for the IMCL facility appear to be adequate and well-maintained, as it is a new facility. Also, the appropriate INL and DOE-ID staff members appear to have a good understanding of how IMCL fire protection systems and MFC support systems function to protect the IMCL facility. In addition, appropriate documentation is in place to support the implementation of an effective program. EA observed one noteworthy practice in that a management assessment of the INL FPP was performed to review 10 CFR 851 requirements pertaining to fire protection, and to ensure that BEA maintains comprehensive, written fire protection criteria or procedures. That management assessment was unique and particularly beneficial, as it considered the relevance of worker safety and health to fire protection.

However, considerable weaknesses were seen in the FPP and its implementation in support of the IMCL facility. For example, it was observed that IMCL is reliant on an aging and degraded water supply infrastructure, which is susceptible to potential failure of degraded components, and which may be challenged in certain stresses (e.g., worst-case fire scenario). In addition, it was observed that, in many cases, program documentation was not properly followed, updated, or implemented.

Overall, increased management attention is needed to ensure that the Findings in Section 7.0 of this report are addressed in a timely manner.

7.0 FINDINGS

As defined in DOE O 227.1 Independent Oversight Program, “findings” indicate significant deficiencies or safety issues that warrant a high level of attention from management. If left uncorrected, findings could adversely affect the DOE mission, the environment, the safety or health of workers, and the public or national security. Findings may identify aspects of a program that do not meet the intent of DOE policy or Federal regulation. Corrective action plans must be developed and implemented for EA appraisal Findings. Cognizant DOE managers must use site- and program-specific issues management processes and systems developed in accordance with DOE O 227.1 to manage these corrective action plans and track them to completion.

IMCL-F-01: The INL FPP, as implemented at MFC in support of the operation of IMCL, does not comply with various DOE O 420.1B requirements or the procedures established to implement these requirements. The INL FPP procedure, LRD-14401, does not describe key responsibilities for the implementation of the FPP; only active systems are being managed using the impairment procedure, LWP-14407; the non-compliant conditions described in the BNA were not processed as equivalencies, and the established compensatory measures were not evaluated for effectiveness; and BNA conclusions, including non-compliances associated with response times and EMS capabilities, were not incorporated into the IMCL FHA.

IMCL-F-02: The IMCL FHA does not classify the facility in accordance with NFPA-45 or identify related requirements, including fire separation, limitations on flammable liquids, means of egress, and fire extinguishing systems.

8.0 OPPORTUNITIES FOR IMPROVEMENT

EA identified the following OFIs. These potential enhancements are not intended to be prescriptive or mandatory. Rather, they are offered to the site to be reviewed and evaluated by the responsible line management organizations and accepted, rejected, or modified as appropriate, in accordance with site-specific program objectives and priorities.

OFI-IMCL-01: Consider discussing and providing analytical detail as to how the IMCL water supply meets the DOE O 420.1B requirement to be adequate and reliable, in lieu of following the DOE STD 1066-99 guidance for it to be part of a redundant system.

OFI-IMCL-02: Consider documenting several important items in the IMCL Pre-Incident Plan, MFC-1729, *Irradiated Materials Characterization Laboratory*, such as fire walls, controls for runoff, and compressed gas storage.

OFI-IMCL-03: Consider increasing the frequency of the FPE's combustibility walkdowns. The IMCL FPE should consider a number of factors, including the number of different tenants occupying the building, to ensure that adequate controls are in place for monitoring transient combustibles.

OFI-IMCL-04: Consider modifying the IMCL process for evaluating deficiencies related to fire protection to evaluate risk in terms of fire protection or consider such critical factors as life safety, unacceptable program interruption, fire loss potential in excess of limits defined by DOE STD 1066-99, and potential damage to process control and safety systems. IMCL should use the risk ranking method in the standard to ensure prompt corrective actions and appropriate compensatory measures and ensure that all risk factors that have a significant impact on frequency and consequence of fire events are considered in the risk analysis.

OFI-IMCL-05: Consider addressing omissions, inconsistencies, and weaknesses in the FHA, the integration of FHA-analyzed hazards with the DSA, and the combustible control program, and consider updating the relevant documents accordingly.

OFI-IMCL-06: Consider updating the LSS ITM procedure, LRD-14403, to reflect the revised NFPA-25 and NFPA-72 standard requirements should be thoroughly communicated to the LSS group to ensure that their procedures are revised accordingly so that fire systems can more readily be maintained to meet the most current requirements.

Appendix A Supplemental Information

Dates of Review

Onsite Review: April 28 – May 2, 2014

Office of Enterprise Assessments Management

Glenn S. Podonsky, Director, Office of Enterprise Assessments
William A. Eckroade, Deputy Director, Office of Enterprise Assessments
Thomas R. Staker, Director, Office of Environment, Safety and Health Assessments
William E. Miller, Director, Office of Nuclear Safety and Environmental Assessments

Quality Review Board

William A. Eckroade
Thomas R. Staker
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Michael A. Kilpatrick

Office of Enterprise Assessments Site Lead for the Idaho Site

Aleem E. Boatright

Office of Enterprise Assessments Reviewers

Aleem E. Boatright – Lead
Jeff Robinson
Joe Panchison

Appendix B

Documents Reviewed and Interviews

Documents Reviewed:

- Irradiated Materials Characterization Laboratory Nuclear Safety Basis Implementation Matrix, LST-794, Rev. 1, 3-18-2014
- IMCL Safety Analysis Report, SAR -418, Rev. 0, 11-26-2013
- IMCL Technical Safety Requirements, TSR-418, Rev. 0, 11/26/2013
- Technical Evaluation, MFC-754A 200,000 gal Water Tank, TEV-1684, 12-17-2012
- Roles and Responsibilities of the Emergency Services Functions, PDD-1065, Rev. 7, 12-15-2008
- INL Fire Protection Authority Having Jurisdiction Program (LRD-14402, Rev. 1, 5-5-2014)
- Safety, Fire Protection, and Industrial Hygiene Functions, Roles, Responsibilities, and Interfaces, LRD-14002, Rev. 3
- Fire Department, PDD-118, Rev. 2, 4-20-2007
- Chemical Storage, DRD-14301, Rev. 3, 4-12-2010
- Handling and Use of Flammable and Combustible Liquids, LRD-14302, Rev. 0, 9-29-2005
- Safety Analysis Process, LWP-10803, Rev. 0, 11-21-2012
- Engineering Change Control, LWP-10501, Rev. 2, 5-24-2013
- Performing Fire Safety Assessments and Abbreviated Fire Assessments, MCP-14403, Rev. 2, 11-04-2013
- IMCL Off-Normal Response Instruction, IMCL-ORNL-0001, Rev. 3, 3-18-2014
- Fire Safety Assessments Periodic Review for MFC, IAS N. 132149, 1-30-2014
- Fire Protection Impairment Tag, Fire Water Storage Tank, MFC-2014-0089
- INL Fire Department Emergency Response Baseline Needs Assessment, INL/INT-10-12550, Rev. 1, 2-2011
- Fire Department Training, PRD-346, Rev. 0, 2-01-2010
- INL Fire Protection Program, LRD-144-1, Rev. 2, 7-9-2009
- INL procedure, Managing Fire Protection Impairments, LWP-14407, Rev. 2, 7-13-2013
- INL Fire Protection Authority Having Jurisdiction Program, LRD-14402, Rev. 1, 5-5-2010
- IMCL Pre-Incident plan, MFC 1729, Irradiated Materials Characterization Laboratory, Rev. 1, March 2014
- MFC-1729, Quick Access Plan, 3-3-2014
- Incident Planning Process, SOP-2.1.3, Rev. 0, 2-16-2012
- INL Combustible Loading Program, LWP-14404, Rev. 0, 11-27-2013
- IMCL Administrative Requirements, SD-47.1.1, Rev. 1, 3/18/2014
- IMCL Combustible Loading Program, SD-47.1.3, Rev. 0, 11/26/2013
- Fire Protection Exemptions and Equivalencies Management Assessment, IAS132137, 2-20-2014
- LWP-13840, Corrective Action System
- Fire Hazards Analysis for the Irradiated Materials Characterization Laboratory at MFC, HAD-465, Rev. 1, 10/1/2013)
- Fire Hazards Analysis for the MFC Area Complex, HAD-432, Rev. 1, 2/11/2014
- Maintaining Facility Chemical Storage Limits, LWP-14301, Rev. 0, 9-29-2005
- Inspection Testing and Maintenance of Fire Protection Systems and Equipment procedure, LRD-14403, Rev. 2, 10-31-2013)
- Triennial Comprehensive Fire Protection Management Self-Assessment, IAS11656, 9-25-2012
- MFC Fire Water Replacement Conceptual Design, CDR-113, Rev. 0, 9/23/2013

- MFC Firewater Supply System Capabilities Relative to the Advanced Post Irradiation Examination Capabilities Project, TEV-1587, Rev. 0, 8/9/2012
- APEX Fire Water Supply Alternatives Selection, TEV-1672, Rev. 0, 11/27/2012

Interviews:

IMCL Fire Engineer
IMCL System Engineer
LSS Maintenance Supervisor
IMCL Utilities Engineer
INL Fire Marshall
INL Fire Chief
IMCL Engineering Manager
IMCL Safety Analysis Manager