

**Office of Enterprise Assessments  
Assessment of the  
Sandia National Laboratories/New Mexico  
Fire Protection Program Implementation**



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**Office of Nuclear Safety and Environmental Assessments  
Office of Environment, Safety and Health Assessments  
Office of Enterprise Assessments  
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## Acronyms

AHJ	Authority Having Jurisdiction
AMP	Water Distribution System Asset Management Plan
BCO	Building Code Official
BFCI	Building Fire Consequence Index
BNA	Baseline Needs Assessment
CFR	Code of Federal Regulations
DOE	U.S. Department of Energy
EA	Office of Enterprise Assessments
FHA	Fire Hazards Analysis
FMOC	Facilities Management and Operations Center
FPE	Fire Protection Engineer
FPP	Fire Protection Program
gpm	Gallons Per Minute
IBC	International Building Code
ITM	Inspection, Testing, and Maintenance
KAFB	Kirtland Air Force Base
MESA	Microsystems and Engineering Sciences Applications
MOC	Management of Change
NFPA	National Fire Protection Association
NNSA	National Nuclear Security Administration
NTESS	National Technology and Engineering Solutions of Sandia, LLC
OFI	Opportunity for Improvement
SA	MESA MicroFab Safety Assessment
SFO	Sandia Field Office
SNL/NM	Sandia National Laboratories/New Mexico
SS	Safety Significant
SSC	Structure, System, and Component
STD	Standard
WO	Work Order

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**EXECUTIVE SUMMARY**

The U.S. Department of Energy (DOE) Office of Nuclear Safety and Environmental Assessments, within the independent Office of Enterprise Assessments (EA), conducted an assessment of the Sandia National Laboratories/New Mexico (SNL/NM) fire protection program as implemented at the Microsystems and Engineering Sciences Applications (MESA) MicroFab 858EF Building, which is operated by National Technology and Engineering Solutions of Sandia, LLC (NTESS). The responsible National Nuclear Security Administration Sandia Field Office (SFO) requested that EA specifically review the NTESS fire protection program in the non-nuclear MESA MicroFab 858EF Building since its fire safety resources were focused on the safety of the nuclear facilities.

The NTESS fire protection program, as implemented for the MESA MicroFab 858EF Building, is appropriately established and maintained. Overall, the fire protection systems are well maintained, and the NTESS personnel interviewed for this assessment have a good understanding of how fire protection systems and support systems function to protect the facility. The Kirtland Air Force Base is sufficiently staffed and equipped to provide emergency response to the MESA MicroFab 858EF Building. EA identified several strengths with the fire protection program, including a strong continuing education program for the fire protection engineering staff, a proactive plan for addressing the aged underground water supply infrastructure piping, and an effective process for monitoring hazardous materials. However, EA identified some findings, namely an outdated fire hazard analysis, fire suppression system seismic vulnerabilities, and hydraulic analyses not supporting the safety assessment performance criteria. Other deficiencies were identified, namely, annual building assessments that are not being adequately performed, combustible loading control inadequacies, implementation deficiencies in inspection, testing, and maintenance of fire protection systems, and some fire protection design features that are not installed according to DOE and National Fire Protection Association standards.

SFO has an adequately documented structure for providing oversight of fire protection programs at SNL/NM. SFO evaluates site programs, using written plans and schedules for assessments, and reviews the contractor's fire protection program self-assessments of processes and systems. SFO has effectively structured its line management oversight of NTESS's fire protection programs and fire protection safety systems at SNL/NM to adequately oversee fire protection safety systems and fire protection program safety management programs.

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## **1.0 PURPOSE**

The U.S. Department of Energy (DOE) Office of Nuclear Safety and Environmental Assessments, within the independent Office of Enterprise Assessments (EA), conducted an assessment of the Sandia National Laboratories/New Mexico (SNL/NM) fire protection program (FPP), as implemented at the Microsystems and Engineering Sciences Applications (MESA) MicroFab 858EF Building (858EF Facility). The purpose of this assessment was to evaluate the implementation of FPP requirements and the adequacy of controls designed to reduce the risk from a fire or explosion at the laboratory facilities. This assessment was designed to evaluate specific core fire protection elements and to provide information to all stakeholders for benchmarking the program's effectiveness. EA conducted the onsite portions of this assessment February 19-23 and March 19-23, 2018.

## **2.0 SCOPE**

As specified in the *Plan for the Office of Enterprise Assessments Assessment of the Fire Protection Program Implementation at Sandia National Laboratories – February 2018*, EA assessed the effectiveness and implementation of selected elements of the FPP, with specific attention to flowdown of program requirements and program implementation at the 858EF Facility, which is operated by National Technology and Engineering Solutions of Sandia, LLC (NTESS), a wholly owned subsidiary of Honeywell International, Incorporated. EA evaluated key elements of NTESS's corporate FPP and the facility-specific FPP requirements at the 858EF Facility, which is a non-nuclear facility. Those key elements included FPP documentation; fire prevention and protection system controls and design requirements; operations, surveillance, testing, and maintenance of fire protection systems; the contractor self-assessment program; configuration management; and the integration of the FPP with the facility safety basis and oversight processes utilized to verify the adequacy of the NTESS FPP. EA also assessed the National Nuclear Security Administration (NNSA) Sandia Field Office (SFO) oversight activities related to fire protection.

## **3.0 BACKGROUND**

SNL/NM is located southeast of Albuquerque, New Mexico, within the Kirtland Air Force Base (KAFB). SFO contracts the management and operation of SNL/NM facilities to NTESS, which also provides facilities and research capabilities to other DOE laboratories through a variety of interlaboratory agreements. Emergency response services to SNL/NM are provided by the KAFB fire department through Support Agreement FB4469-00286-610, dated September 28, 2014, between the Department of the Air Force, 377th Air Wing, and NNSA.

In preparation for this assessment, EA coordinated with SFO, which suggested that the assessment focus on the 858EF Facility. The 858EF Facility designs, prototypes, and manufactures qualified microsystems-based components to support programs of national interest. While the 858EF Facility is non-nuclear, it does have a safety analysis, *MESA MicroFab Safety Assessment (SA)*, and a safety basis process manual MN471017, *Safety Basis Manual*. The SA identifies and evaluates hazards related to the MicroFab facility, including operations and other activities, and the manual describes the SNL/NM safety

basis process that ensures centralized and consistent implementation of safety basis development, documentation, and evaluation.

SFO provides oversight of SNL/NM through a process utilizing five Assistant Manager Offices, which report directly to the SFO Manager. For this assessment, EA worked primarily with the SFO Operations Office, which provides oversight of the contractor's FPP.

#### **4.0 METHODOLOGY**

The DOE independent oversight program is described in and governed by DOE Order 227.1A, *Independent Oversight Program*. EA implements the independent oversight program through a comprehensive set of internal protocols, operating practices, assessment guides, and process guides. Organizations and programs within DOE use varying terms to document specific assessment results. In this report, EA uses the terms “deficiencies, findings, and opportunities for improvement (OFIs)” as defined in DOE Order 227.1A. In accordance with DOE Order 227.1A, DOE line management and/or contractor organizations must develop and implement corrective action plans for the deficiencies identified as findings. Other important deficiencies not meeting the criteria for a finding are also highlighted in the report and summarized in Appendix C. These deficiencies should be addressed consistent with site-specific issues management procedures.

As identified in the assessment plan, this assessment considered requirements related to FPP implementation at the MESA 858EF Facility. Specific assessment activities at the 858EF Facility focused on hazard analyses; fire protection systems; combustible controls; inspection, testing, and maintenance (ITM) of fire protection systems; and, fire department response. EA used sections of Criteria and Review Approach Document 31-12, Rev. 1, *Fire Protection Program*, dated January 25, 2018:

- 4.1 Fire Protection Program
- 4.2 Fire Prevention and Protection Structures, Systems, and Components (SSCs) and Design Requirements
- 4.3 Operations, Surveillance, Testing and Maintenance
- 4.4 Contractor Self-Assessment Program
- 4.5 Configuration Management.

EA examined key documents, such as system descriptions, work packages, procedures, manuals, analyses, policies, training and qualification records, and numerous other documents. EA also conducted interviews of key personnel responsible for developing, executing, and monitoring the associated systems and programs, including maintenance projects and tracking corrective actions to closure. EA walked down significant portions of the 858EF Facility to evaluate the effectiveness of the SNL/NM FPP as it is implemented at the 858EF Facility.

The members of the EA assessment team, the Quality Review Board, and EA management responsible for this assessment are listed in Appendix A. A detailed list of the documents reviewed, personnel interviewed, and observations made during this assessment, relevant to the findings and conclusions of this report, is provided in Appendix B.

No previous EA FPP assessments have been performed at either SNL/NM or at the 858EF Facility; therefore, there were no items for follow-up during this assessment.

## 5.0 RESULTS

This section discusses EA's assessment of SNL/NM's FPP as implemented at the 858EF Facility.

### 5.1 Fire Protection Program

EA reviewed the policy, program, and procedures to determine whether NTESS's management has established requirements for comprehensive FPPs in DOE facilities and emergency response organizations to ensure effective implementation and control of all fire protection activities. (10 CFR Part 851; DOE Order 420.1C, Chg 1, *Facility Safety*, Attachment 2, Chapter II, *Fire Protection*)

#### 5.1.1 Fire Protection Program Policy

*Criterion:*

*The site contractor has an established Policy Statement that affirms the contractor's commitment to provide a comprehensive fire protection and emergency response program in accordance with applicable DOE directives and other related requirements. (DOE Order 420.1C, Attachment 2, Chapter II)*

The FPP policy is formally established in POL-001, *Corporate Fire Protection Program Policy*. The policy specifies that SFO has exercised its option to assign certain Building Official/Authority Having Jurisdiction (AHJ) responsibilities to NTESS, which are defined in the *Assignment of Fire Protection Authority Having Jurisdiction (AHJ), Building Code Official (BCO), and Owner Responsibilities to Sandia Corporation (Sandia)*. NTESS commits to maintaining sufficient qualified and trained fire protection staff to achieve operational and fiduciary excellence, including concepts of highly protected risk and defense-in-depth approaches to comply with DOE fire safety objectives. To accomplish this commitment, NTESS has implemented a strong continuing education program for the fire protection engineering staff, which EA considers to be a strength. The SNL/NM policy statement adequately affirms NTESS's commitment to provide a comprehensive fire protection and emergency response program as required by DOE directives and other related requirements, such as 10 CFR Part 851, *Worker Safety and Health Program*, and the applicable building code and National Fire Protection Association (NFPA) codes and standards.

#### 5.1.2 Codes and Standards

*Criterion:*

*The applicable building code and NFPA codes and standards are identified in the fire protection and emergency response programs. (DOE Order 420.1C, Attachment 2, Chapter II; applicable codes and standards from the site-specific contract)*

The FPP policy statement, POL-001, commits NTESS to meet or exceed the applicable building code and NFPA codes and standards. PGM-003, *Corporate Fire Protection Program*, establishes this commitment through the flowdown of requirements from DOE Order 420.1C and 10 CFR 851. This commitment includes employing a model that mandates the International Building Code (IBC) and applicable NFPA codes/standards be contained in design standard manuals for construction requirements as well as applying NFPA codes and standards for operational conditions such as the ITM of fire protection systems. Working documents reviewed as part of this assessment utilize codes and standards in the baseline needs assessment (BNA), work orders for conducting ITM, hot work permits, and the site wildland fire management plan.

### **5.1.3 FPP Programmatic Elements**

*Criterion:*

*A documented FPP exists as required by applicable safety criteria and includes the elements and requirements for design and operations, emergency response, fire analysis and assessments, wildland fire, and site-specific fire protection criteria. (10 CFR Part 851; DOE Order 420.1C, Attachment 2, Chapter II)*

EA reviewed and confirmed that FPP elements are adequately documented in PGM-003, which was reviewed and approved by SFO via letter 703584, November 3, 2016, as required by DOE Order 420.1C, Attachment 2, Chapter II, Section 3.b(1).

### **5.1.4 Fire Hazards Analyses (FHAs), Combustible Controls, and Building Fire Protection Assessments**

*Criteria:*

*An FHA has been prepared for the facility and reviewed every three years by a fire protection engineer (FPE) and revised as appropriate. (DOE Order 420.1C, Attachment 2, Chapter II)*

*The FHA has been adequately revised to accommodate changes to the facility, processes (operations), occupancy, safety basis, or BNA; or when new fire safety risks are introduced. (DOE Order 420.1C, Attachment 2, Chapter II)*

*The results of the FHA have been coordinated with and integrated into the facility safety basis. (10 CFR Part 851; DOE Order 420.1C, Attachment 2, Chapter II; NFPA 801)*

*Fire and related safety hazards on site (or within the facility) have been identified and evaluated in conjunction with the current and comprehensive FHA and building FPP assessments. (DOE Order 420.1C, Attachment 2, Chapter II)*

*A complete spectrum of fire prevention combustible controls and procedures has been developed and implemented as required by applicable fire safety criteria. (DOE Order 420.1C, Attachment 2, Chapter II)*

*Facility fire protection assessments are conducted annually for facilities valued over \$100 million dollars, facilities considered a high hazard, or those with vital programs; or at least every three years for low and ordinary hazard facilities; or at a frequency with appropriate justification approved by the DOE head of field element. (DOE Order 420.1C, Attachment 2, Chapter II)*

### **Fire Hazards Analysis**

As required by DOE Order 420.1C and PGM-003, Section 3.4, an FHA is required to be prepared for facilities that represent unique fire safety risks, new facilities or modifications to existing facilities with values greater than \$150 million, or when directed by the responsible DOE authority. The 858EF Facility represents unique fire safety risks, including maintaining stores of pyrophoric gases and solids, chlorine gas, hydrogen gas, and various other toxic and hazardous chemicals in both liquid and solid forms, in and around a facility that is critical to national security. Further requirements specify that the FHA, which was last revised for the 858EF Facility in 2006, be reviewed every three years, and if no revision to the FHA is necessary, this determination must be documented following the review. The FHA is required to be revised when the facility is changed, a modification to an associated facility or process adds a significant new fire safety risk, or the periodic three-year review identifies the need for changes. The



2006 FHA is not being reviewed or updated every three years. The 858EF Facility operates under a safety basis document, *MESA MicroFab Safety Assessment*, that requires annual revisions to accommodate changes to 858EF Facility applications, tools, and processes. These changes potentially introduce new hazards that can affect the fire safety objectives of the facility.

EA reviewed the latest version of FHA 04-3027.100, Revision 1, *Title III Final Fire Hazards Analysis Microsystems and Engineering Sciences (MESA) Project Microfabrication Facility (Building 858 East) and Central Utilities Building No. 1 (Building 858J)*, May 23, 2006. This FHA does not provide an analysis of operations; the design basis fire scenarios; the potential for a toxic release due to a fire; fire protection features (i.e., sprinkler systems); the ventilation and exhaust safety systems; or the effect of significant fire safety deficiencies on fire risk. As such, the December 2016 SA was not developed or revised in coordination with a current FHA to reflect all relevant fire safety objectives. EA concludes that NTESS is not adequately analyzing current hazards in the 858EF Facility. Additionally, contrary to the requirements of DOE Order 420.1C, Attachment 2, Chapter II, Section 3.f(1) and PGM-003, Section 3.4, the 858EF Facility FHA is not being maintained current and the technical content and analysis of operations is inadequate. (See **Finding F-NTESS-1**.)

### **Combustible Controls**

NTESS provided FAC100.2.4, *Manage Fire Protection Requirements*, as the procedure for controlling and managing combustibles in the 858EF Facility. FAC100.2.4 is a general descriptions document for FPP requirements and does not establish baseline standards for managing risks associated with the use and storage of combustible material. Per DOE Order 420.1C, a combustible control program is a required element of the FPP, and written criteria and procedures are to be established for implementing the controls. During walkthroughs of the 858EF Facility subfab basement, which is a large mechanical room, EA observed storage of combustible materials in Bays 12 through 14. The storage consisted of numerous out-of-service computer monitors wrapped in plastic, keyboards, plastic wrapping, cardboard boxes, and shelving that contained old monitoring instrumentation and miscellaneous equipment. FAC100.2.4 does not adequately control the combustible material in Bays 12 through 14.

Although FAC100.2.4 provides minimal criteria for the use and storage of flammable and combustible material, the combustible control program does not meet requirements as specified in DOE Order 420.1C, Attachment 2, Chapter II, Section 3.d(1)(d), which requires that comprehensive written fire protection criteria and procedures be established for the use and storage of combustible, flammable, and hazardous materials (**Deficiency**).

### **Facility Fire Protection Assessments**

Requirements for performing facility fire protection assessments are established in Section 3.7 of PGM-003, which specifies that fire protection assessments be conducted at a 1-, 3-, or 5-year frequency. PCD-037, *Performing Fire Protection Assessments: Overview*, documents the instructions for conducting a fire protection assessment; establishes the responsibilities of the assessor evaluating the facility FPP; and provides criteria for summing the Building Fire Consequence Index (BFCI) scoring that determines the facility fire protection assessment frequency, which requires approval from SFO. The 858EF Facility fire protection assessment is performed annually based on BFCI scoring criteria and consists of four elements: ITM review, hazardous materials chemical information system maximum allowable quantity analysis, pre-incident plan review, and a facility walkthrough. To verify the implementation of PCD-037, EA evaluated two of the four elements, the sprinkler system ITM review and the facility walkthrough.

PCD-037 requires the assessor performing the ITM review to evaluate records for completeness. EA reviewed the 2016 and 2017 ITM checklists for the 858EF Facility, which consist of a compilation of

quarterly, semi-annual, and annual records. The checklists from 2016 and the first quarter 2017 checklist provide a block for the FPE signature and the review date. None of the checklists were signed and dated by an FPE. The remaining 2017 checklists had the signature and review date removed from the form, providing no means to record the FPE's ITM review. Other issues and inconsistencies regarding ITM records are discussed in Section 5.3 of this report. Based on information provided for the 858EF Facility assessment ITM review, EA could not confirm that NTESS FPEs are performing required ITM reviews in accordance with PCD-037, Sections 3.1.2 and 3.2 (**Deficiency**).

EA also reviewed the building assessment facility walkthrough. PCD-037, Section 3.1.5, specifies that a walkthrough of the facility be performed using PCD-111, *Performing Fire Protection Assessments: Facility Walk-through*, with results documented on form FRM-056, *Fire Protection Systems Summary*. Consistent with DOE-STD-1066-2012, *Fire Protection*, Section 7.2, PCD-111, Section 3.1, requires that the facility walkthrough be completed by or under the supervision of an FPE. For non-nuclear facilities such as the 858EF Facility, SFO approved a permanent equivalency, *Building Safety and Assurance (4879)*, dated August 2011, that allows annual visual inspections of sprinklers, piping, and hangers to be conducted at the same frequency as the building fire protection assessment. PCD-111 requires a physical walkthrough of the facility to evaluate sprinkler systems, fire alarm systems, life safety features, housekeeping, chemical storage, and other relevant criteria. Findings identified during the walkthrough are to be entered into the findings database and processed for resolution. EA concludes that PCD-111 adequately addresses requirements for performing the facility walkthrough, including identifying and correcting deficiencies in the FPP.

Results of the 858EF Facility assessment walkthrough, as documented in form FRM-056, *858EF Fire Protection Systems Summary*, dated January 17, 2018, were reviewed to confirm, in part, that the facility assessment adequately evaluates the FPP elements and identifies deficiencies for correction to improve the 858EF Facility FPP. During walkthroughs of the subfab basement, EA observed fire sprinkler obstructions around Column Q.5/Bay 3 through Column 11.9/Bay 9. PCD-111, Section 3.1, requires the physical walkthrough of the facility to assess sprinkler systems, while PCD-037, Table 3.3, *Consequence Categorization*, specifies a sprinkler system impairment as a moderate consequence, and also provides sprinkler obstructions as an example of an impairment. Furthermore, the permanent equivalency discussed earlier was approved based on visual inspections of sprinklers, piping, and hangers being performed in conjunction with the building fire protection assessment. While most of the building operations features were adequately evaluated, the facility walkthrough did not address the assessment of the sprinkler systems as required by Section 3.1 of PCD-111 and the SFO-approved permanent equivalency. PCD-037 and FRM-056 do not provide sprinkler system assessment criteria that ensures obstructions will not affect full required sprinkler coverage as required by PCD-111, section 3.1 (**Deficiency**).

During walkthroughs, EA also noted that some floor/ceiling penetrations lacked penetration seals near Columns 10.1 and 11.9. FRM-056 indicates that penetrations in fire walls, barriers, and partitions are not protected with approved firestop systems. However, the location(s) and type of unsealed penetration(s) were not recorded in the comments section. It was indeterminate whether the unprotected penetrations recorded on FRM-056 were the same penetrations EA identified during walkthroughs of the subfab basement. Further discussion on the floor/ceiling penetrations is provided in Section 5.2.2 of this report. NTESS does not require the assessor to record in the comments section the locations and brief descriptions of issues identified during facility assessment walkthroughs.

Furthermore, once a building assessment frequency is assigned using BFCI criteria and is approved by SFO, NTESS does not provide direction for recording the established frequency. Through interviews with the FPEs, EA determined that the 858EF Facility assessment frequency changed in 2017 from a three-year to an annual frequency based on BFCI scoring criteria. However, this frequency is not

documented in the FPP, such as in PCD-037 or PCD-111. Assessment frequencies and/or an assessment schedule are not included in the building fire protection assessment program.

### 5.1.5 Baseline Needs Assessment

*Criterion:*

*The site emergency response capabilities meet site needs as established in the baseline needs assessment (BNA), safety basis requirements, and applicable regulations, codes and standards. (DOE Order 420.1C, Attachment 2, Chapter II; applicable codes and standards from the site-specific contract; site FPP description document; site emergency preparedness program)*

NTESS is responsible for maintaining and updating the SNL/NM sitewide BNA. The BNA for SNL/NM is comprised of two documents: Facilities Management and Operations Center (FMOC), *SNL/NM Emergency Response Baseline Needs Assessment*, and FMOC, *SNL/NM Emergency Response Compliance Assessment*. The BNA describes what emergency response services are required for SNL/NM, using protection goals that are defined in DOE Order 420.1C, DOE-STD-1066-2012, and applicable NFPA codes and standards. The established baseline addresses structural firefighting, wildland firefighting, emergency medical service, hazardous material response, technical rescue, emergency communications, training and certifications, pre-incident plans, and fire response apparatus. These topics include defined minimum requirements for staffing and response times, training, emergency communication and alarm dispatch, pre-incident plan review frequency, and front-line/reserve emergency fire and medical apparatus. The BNA also discusses the site description, fire department organizations, and a list of requirements and guidance documents. EA concluded that the BNA is adequate and complies with the requirements of DOE Order 420.1C, Attachment 2, Chapter II, Section 6.1.

The BNA Compliance Assessment is a self-assessment describing how well SNL/NM meets the requirements described in the BNA. The 2016 Compliance Assessment identified three findings: fire department response times and staffing for structure firefighting, Medical Priority Dispatch System, and medical emergency non-business hours response times. The BNA was approved by SFO via letter 729312, *Approval of the Sandia National Laboratories/New Mexico Base Line Needs Assessment*, under the condition that NTESS address the deficiencies identified in the BNA. To address the three findings, NTESS submitted two equivalency requests to SFO on December 18, 2017.

The first equivalency request, *NFPA 1710 Structural Firefighting Staffing and Response Times*, provided a justification that is consistent with the Support Agreement between the U.S. Air Force, 377th Air Wing, and NNSA. The Support Agreement requires that emergency response services be provided in accordance with U.S. Air Force Instruction 32-2001, *Fire and Emergency Service (FES) Program*. Justification for staffing is based on the KAFB fire department structure, back-up resources at multiple fire department locations, multi-task training for KAFB firefighters, and a mutual aid agreement between KAFB and the City of Albuquerque Fire Department. The second equivalency request, *NFPA 1710 Emergency Medical Response Times*, addressed the Medical Priority Dispatch System and medical emergency non-business hours response times. The justification was based on the fact that the majority of emergency medical service requests are not time-critical, life-threatening medical emergencies. Continued use of the Medical Priority Dispatch System allows first responders to slow their response based on the categorization of the call and urgency to the scene, providing a safer environment for both the responders and the public due to reducing the risk of a vehicle accident. At the time of this assessment, SFO had not formally responded to the two equivalency requests.

The SNL/NM BNA is being reviewed at least every three years as required by DOE Order 420.1C, Attachment 2, Chapter II, Section 3.e(1)(d), and the compilation of these assessments adequately analyzes the emergency response needs for SNL/NM as outlined in DOE-STD-1066-2012, Section 6.

### **5.1.6 Pre-Incident Plans**

*Criterion:*

*Pre-incident strategies, plans, and standard operating procedures have been established to enhance the effectiveness of emergency response activities. (DOE Order 420.1C, Attachment 2, Chapter II)*

The NTESS program for developing pre-incident plans is established in PCD-103, *Developing Pre-Incident Plans*, which defines how SNL/NM FMOC, SNL/NM Emergency Management, and the KAFB fire department develop and maintain pre-incident plans to effectively manage and respond to fires at SNL/NM. Typically, pre-incident plans are prepared and maintained by the onsite fire department. In accordance with the Support Agreement, SNL/NM is required to develop, maintain, and submit pre-incident plans to SFO, which transmits the plans electronically to the KAFB fire department for approval and input into its computer system.

EA reviewed *Pre-Incident Plan - Building 858EF*, dated December 19, 2016, and determined that the document is maintained current and is reviewed and revised as necessary on a three-year frequency. Information provided in the pre-incident plan is consistent with NFPA 1620, *Standard for Pre-Incident Planning*, and DOE-STD-1066-2012. The plan is stored in the SNL/NM FileNet Corporate Document Management System, making it readily available to the KAFB fire department and SNL/NM's FMOC and Emergency Management organization. However, the Support Agreement does not discuss a process to ensure that the KAFB fire department maintains a current revision of SNL/NM pre-incident fire plans. This concern was previously identified by SFO in ASRP-OPS-3.22.2017-726496, *Fire Protection Program Joint Assessment Review for the Sandia National Laboratories, New Mexico Site*.

With the exception of the SFO-identified concern, the 858EF Facility pre-incident plan is consistent with guidelines established in NFPA 1620 and meets the expectations of DOE Order 420.1C, Attachment 2, Chapter II, Section 3.e(2).

### **5.1.7 Wildland Fire**

*Criterion:*

*Consistent with the Federal Wildland Fire Management Policy, the site contractor has an integrated site-wide wildland fire management plan that has been established and implemented in accordance with relevant portions of NFPA 1143, Standards for Wildland Fire Management. (DOE Order 420.1C, Attachment 2, Chapter II)*

SNL has established and implemented a sitewide Wildland Fire Management Plan as recorded in PCD-039, *Wildland Fire Management Plan for SNL/NM*, that documents the structure and approach to implement an integrated sitewide fire management plan as required in DOE Order 420.1C, Attachment 2, Chapter II, Section 3.g. The plan addresses five technical areas that are mostly located on DOE-owned/managed land within the KAFB boundaries and remote test areas and other wildlands controlled and managed by DOE/NNSA. The total gross acreage of DOE land (owned, leased, withdrawn, and/or use-permitted via KAFB) at SNL/NM is approximately 8,824 acres.

The plan signifies that SFO and SNL/NM have an active program of coordinating activities with KAFB and the U.S. Forest Service on vegetation control programs. It also requires SNL/NM fire protection engineering to conduct a wildland fire protection assessment twice a year that covers all remote areas where wildfire is a potential threat. Since the plan was developed in February 2018, an assessment had not yet been performed. The wildland fire protection engineering assessment is identified as a follow-up item in Section 8.0 of this report.

### **5.1.8 Fire Protection Program Conclusion**

SNL/NM has a comprehensive documented FPP that includes an established policy statement and procedures, using applicable building codes and NFPA codes and standards. The BNA adequately describes the emergency response program with the Department of the Air Force and the NNSA as documented in a Support Agreement and is consistent with the requirements of DOE Order 420.1C. The FPP includes those elements and requirements for design, operations, emergency response, fire analysis and assessments, and wildland fire. However, significant management attention is required to ensure that the FHA is maintained current with DOE requirements and that the analysis includes technical content and analysis of operations that is adequate to ensure that the risk from fire in the 858EF Facility is assessed and that fire safety objectives are met. Additionally, the combustible control program does not meet requirements as specified in DOE Order 420.1C, and the 858EF Facility assessment is deficient in performing required ITM reviews and sprinkler system evaluations to ensure that obstructions do not affect required sprinkler coverage.

### **5.2 Fire Prevention and Protection Structures, Systems, and Components (SSCs) and Design Requirements**

EA reviewed the engineering design documents and analyses to determine whether they are technically adequate and implement the requirements of the facility safety basis such that adequate protection of the public, the workers, and the environment from fires and other hazards is demonstrated. (10 CFR 851; DOE Order 420.1C, Attachment 2, Chapter II, *Fire Protection*)

#### **5.2.1 Design Basis Documentation and Design Requirements**

*Criteria:*

*Key design documents, including design basis and supporting documents, are established to support facility safety basis development and implementation. (10 CFR Part 851; DOE Order 420.1C, Attachment 2, Chapter II; applicable NFPA codes and standards from the site-specific contract)*

*Fire protection design requirements are documented and incorporated into plans and specifications, including protection thresholds that are consistent with the safety authorization basis and FHA. (10 CFR Part 851; DOE Order 420.1C, Attachment 2, Chapter II; site documented safety analysis; applicable NFPA codes and standards from the site-specific contract)*

*A complete spectrum of fire prevention controls and procedures has been developed and implemented as required by applicable fire safety criteria. (10 CFR Part 851.22; DOE Order 420.1C, Attachment 2, Chapter II; applicable NFPA codes and standards from the site-specific contract)*

EA reviewed the fire suppression system at the 858EF Facility to confirm, in part, that the fire protection system is appropriate for the facility fire scenarios identified in the *MESA MicroFab Safety Assessment*; that the fire suppression system is designed and installed compliant with the required codes and standards; and that an appropriate ITM program for fire protection features is in place and is being conducted. The SA conforms to SNL/NM Manual MN471017, which identifies the processes and methods used to develop safety basis documentation that is prepared and implemented to ensure that work is performed safely. The SNL/NM safety basis process applies to both medium- and high-hazard industrial facility operations and nuclear facility operations. Although the MicroFab facility is not contractually committed to DOE-STD-3009, *Preparation Of Nonreactor Nuclear Facility Documented Safety Analysis*, the MicroFab SA conforms in many respects to the standard. For each of the basic processes performed in the MicroFab, the SA identifies and evaluates the associated process hazards. Based on the process

hazards, the SA identifies credible accident scenarios and credited control strategies to mitigate the consequences of an accident to the workers and the public.

However, EA identified two significant issues regarding the fire protection system as described in the SA. The first issue involved the fire suppression system, which is identified in the SA as a Safety Significant (SS) active engineered control that mitigates the consequences of fire scenarios postulated in the SA for the MicroFab facility. The fire suppression system is credited as an SS control during and after a seismically-induced fire. As such, the fire suppression system is classified as seismic category PC-2 and is therefore required to meet system seismic interaction “two over one protection” criteria<sup>1</sup> as required by DOE-STD-1021, Chg Notice 1, *Natural Phenomena Hazards Performance Categorization Guidelines for Structures, Systems, and Components*, and the MicroFab SA. EA identified non-seismically qualified systems that could compromise fire suppression operability. One example involved fire suppression system seismic category PC-2 piping located in the MicroFab Fan Deck that was under, and supported by, the non-seismically qualified make-up air ventilation system. This same concern was noted in the subfab basement as well. DOE Order 420.1C, Attachment 3, states, in part, that supporting or interfacing SSCs must be designed as SS SSCs if their failures prevent safety SSCs or specific administrative controls from performing their safety functions. (See **Finding F-NTESS-2**.)

The second issue involved the lack of hydraulic analyses to support the fire suppression system as required by performance criteria in the SA. The automatic sprinkler system is required to supply a minimum water supply of 0.40 gallons per minute (gpm) per square foot (sq ft) throughout the chemical storage and specialty gas rooms, plus a 750-gpm hose allowance. The flammable liquid storage room is required to have a water supply of 0.60 gpm per sq ft throughout. EA reviewed the hydraulic analyses to determine whether they demonstrate the fire protection performance capability. In some instances, the performance capability was analyzed to less stringent performance requirement inputs than those stated as a requirement in the SA; therefore, the required performance of the fire suppression system in these design areas is not demonstrated by analysis and is nonconservative. An engineering evaluation or calculation is required to assess the performance capabilities of safety SSCs. The evaluation must determine the adequacy of the safety SSCs and demonstrate that they meet or exceed performance criteria as stated in the SA for the SSCs to ensure that functional requirements are met under postulated accident conditions. (See **Finding F-NTESS-3**.)

## 5.2.2 Engineering

### *Criterion:*

*Engineered SSCs and processes are designed using sound engineering/scientific principles and appropriate standards. (10 CFR 851, Appendix A)*

Engineered fire protection SSCs were generally found to be designed appropriately to consensus design standards using applicable engineering design principles. However, based on observations made during facility walkdowns, EA determined that the facility fire protection design configuration deviates from requirements identified in DOE Order 420.1C related to fire-rated barriers. The subfab basement ceiling penetrations were, in some cases, open with no penetration seal or only partially sealed with no contiguous penetration sealing material. This observation was made at Columns 10.1 and 11.9/Bay 12. DOE Order 420.1C requires that complete fire-rated construction and barriers, commensurate with the

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<sup>1</sup> The potential interaction of non-seismically-designed equipment upon seismically-designed equipment is referred to commercially as “two over one” considerations. This is derived from the seismic level II (non-seismically-designed) and seismic level I (seismically-designed) designations as defined in DOE-STD-1020, *Natural Phenomena Hazards Analysis and Design Criteria for DOE Facilities*, and ANSI/ANS-2.26, *Categorization of Nuclear Facility SSCs for Seismic Design*.

applicable codes and/or safety basis requirements, must be provided to isolate hazardous areas and minimize fire spread and loss potential. Furthermore, as stated in Section 3.3.1 of the MicroFab FHA and IBC Section 302.3.3, each portion of the building is required to be individually classified according to use and must be completely separated from adjacent areas by fire barrier walls or horizontal assemblies having a fire-resistance rating determined in accordance with Table 302.3.3 of the IBC. In these instances, the subfab and the first floor assembly area are classified as H-5, thereby requiring a two-hour rated barrier (**Deficiency**).

Additionally, EA noted that, in some areas of the subfab basement, fire suppression sprinkler obstructions would prevent full required sprinkler coverage. Ceiling-level sprinklers were observed to be obstructed by dense piping and ducts, thereby inhibiting the full sprinkler coverage discharge pattern required by NFPA 13. EA identified sprinkler obstructions at Column Q.5/Bay 3 and Column 11.9/Bay 9 (**Deficiency**).

EA performed interviews and reviewed documentation of the Sandia underground water supply infrastructure. According to EA's review, aged underground water supply infrastructure piping is being proactively addressed, and plans to incrementally replace aged piping are covered by the Water Distribution System Asset Management Plan (AMP). The AMP process involves completing a condition assessment and developing a ranking system to prioritize rehabilitation and replacement needs. The AMP uses a risk-based condition assessment to prioritize waterline replacement and provides recommendations for a 20-year replacement plan. Throughout the underground piping infrastructure, the system is provided with sectional control valves consisting primarily of post indicator valves and outside screw and yoke type valves. These valves are cycled annually to demonstrate operability, consistent with NFPA ITM requirements. The scope of the AMP includes the water distribution main lines, associated valves, and fire hydrants. Water storage tanks, pump stations, water meters, and other appurtenances were excluded from this study. EA considers the AMP a strength.

EA also interviewed NTESS staff and reviewed procedure documentation to confirm that a process is in place that monitors and verifies MicroFab hazardous material limits and that hazardous material is maintained for each control area within prescribed limits as defined in the facility SA. Based on the document and facility reviews, the MicroFab has a comprehensive written process and procedures to support the use and quantity limitation of hazardous material including flammable and combustible liquids. The FPE team utilizes the Maximum Allowable Quantity (MAQ) process, as defined in Procedure PCS.072 to monitor hazardous material quantities. EA considers the MAQ process a strength.

### **5.2.3 Fire Prevention and Protection SSCs and Design Requirements Conclusion**

SNL/NM has a comprehensive and proactive program to maintain a reliable and adequate underground water supply distribution system through implementation of the AMP. A comprehensive process is employed to manage and monitor hazardous material quantities for each facility control area. However, the fire suppression system did not conform to seismic system interaction criteria as credited in the SA. Additionally, analyses do not exist to support fire suppression performance criteria credited in the SA. EA noted other deficiencies regarding fire suppression sprinkler obstructions and missing or nonconforming fire-rated barrier penetration seals.

### **5.3 Operations, Surveillance, Testing, and Maintenance**

EA reviewed the installation and operation of fire protection SSCs, and implementation of the FPP controls and procedures intended to ensure that the safety systems are available to perform their intended safety functions when required. In addition, EA reviewed whether ITM activities are properly planned,

scheduled, and performed to ensure that fire protection systems can reliably perform their intended safety functions when required. (DOE Order 420.1C)

### 5.3.1 Fire Safety Systems Installation, Operation, Testing and Maintenance

*Criterion:*

*All fixed fire protection features (e.g., appropriate construction types, fire barriers, fire alarm and signaling systems, manual and automatic fire suppression systems), that are required by authorization basis documents and FHAs, have been installed and are tested and maintained, as required by applicable fire safety criteria. (DOE Order 420.1C, Attachment 2, Chapter II; applicable NFPA codes and standards from the site-specific contract)*

PCD-042, *Maintaining Fire Protection Systems*, defines work processes for the acceptance and ITM of fire protection systems, and includes instructions for documenting, evaluating, and resolving deficiencies identified during ITM activities. The program also addresses performance metrics to determine trends where system performance is declining and provides requirements for retaining ITM records. The program document is generally adequate and is consistent with NFPA codes and standards for establishing ITM frequencies and minimum acceptance criteria.

EA reviewed a sample of ITM records for fire dampers installed in ducts located in the flammable liquids and chemical storage room. NTESS provided WO# 20170423497, *858EF Fire Damper Building Record*, dated June 3, 2017, that had no completion date and no test data to confirm that the dampers had been inspected and tested.

For water-based fire suppression systems in a non-nuclear facility, such as the 858EF Facility, SFO has approved a permanent equivalency, *Building Safety and Assurance (4879)*, August 2011, that allows monthly visual inspections to be changed to a quarterly frequency, and annual visual inspections of sprinklers, piping, and hangers to be conducted at the same frequency as the building fire protection assessment. EA reviewed the 2016 and 2017 sprinkler system ITM checklists and determined that some checklists were incomplete, omitting such elements as verifying operation of the local sprinkler alarms; recording pressure gauge and trip pressure readings; recording semi-annual water flow alarm times; or confirming accessibility, damage, and signage of system control valves. Additionally, as discussed in the fire protection building assessment section of this report, the 2017 checklists that had the FPE signature and date removed, had an “FACP [Fire Alarm Control Panel] No Action Start Time” and “End Time” stamped with red ink in the blocks. However, no times were recorded in these fields.

EA also identified inconsistencies with frequencies established on checklists versus dates when the ITM was performed. For example, the 2016 second quarter semi-annual tests scheduled for May (WO# 20160242885) were completed July 30, 2016; the 2017 second quarter semi-annual tests scheduled for May (WO# 20170299019) were completed June 13, 2017; and the 2017 third quarter annual tests scheduled for November (WO # 20170299019) were completed three months early on June 8, 2017. Additionally, WO# 20170299019 for the 2017 second quarter semi-annual tests in May was also recorded as the WO# for performing the 2017 third quarter annual tests in November. NTESS test performance has not been timely and has not met the expectations of the approved equivalency.

Additionally, results for fire damper inspection and tests are not documented. Although self-identified on September 26, 2016, and documented in corrective analysis 46876, *Fire Damper Documentation as Per NFPA 80*, September 26, 2016, NTESS has not implemented a process to proactively correct and close this issue in a timely manner.



Inconsistencies exist with water-based fire suppression system records and results of fire damper inspection and tests are not documented. These issues are contrary to the requirements of DOE Order 420.1C that state that a configuration management program must be established and implemented that ensures consistency among system requirements and performance criteria, system documentation, and physical configuration of the systems within the scope of the program to include system design and test documentation (**Deficiency**).

EA observed a flow test of the underground water supply feeding the 858EF Facility sprinkler systems. The test was performed under the supervision of an FPE and in accordance with PCD-110, *Sandia National Laboratories Hydrant Flow Test*. Current calibration sheets were provided for all instrumentation used in measuring flows and pressures, and field data was correctly recorded on form FRM-039, *Hydrant Flow Test Form*. The fire water flow tests at the 858EF Facility are being conducted in accordance with NFPA 25 requirements.

### **5.3.2 Applicable System Requirements and Performance Criteria**

*Criterion:*

*Surveillance and testing of the fire protection system demonstrates that the system is capable of accomplishing its safety functions and continues to meet applicable system requirements and performance criteria. (DOE Order 420.1C, Attachment 2, Chapter II; applicable NFPA codes and standards from the site-specific contract)*

In most cases, surveillance testing and ITM of fire protection systems and water distribution systems conform with applicable codes and standards. However, EA determined that the performance test results of annual hydrant flow testing are not formally compared against the flow test supply curve data documented in facility hydraulic calculations of record for the sprinkler risers that supply water to the MicroFab facility. Attachment 3 to DOE Order 420.1C requires that safety SSCs must be designed with appropriate margins of safety, as defined in applicable DOE or industry codes and standards. DOE-STD-1066-2012 requires that hydraulically designed sprinkler systems be designed for a supply pressure of at least 10 percent below the water supply curve to provide a pressure margin to accommodate minor system modifications, or degradation of the water supply and sprinkler systems that may occur over time.

### **5.3.3 Operations, Surveillance, Testing, and Maintenance Conclusion**

Program document PCD-042 defines work processes for the acceptance and ITM of fire protection systems, and is generally consistent with NFPA codes and standards in establishing ITM frequencies and minimum acceptance criteria. However, EA identified deficiencies regarding the implementation of the ITM program requirements, including lapses in verification that required ITM was actually performed on fire dampers; inconsistencies in sprinkler system testing documentation; and the lack of formal documentation of hydrant water supply flow characteristic degradation compared to water supply characteristics documented in design basis performance fire protection hydraulic calculations.

### **5.4 Contractor Self-Assessment Program**

EA reviewed the contractor's documented self-assessment of the FPP to verify that it is comprehensive and performed by the site contractor at least every three years, or at a frequency with appropriate justification approved by the DOE head of the field element. (DOE Order 420.1C, Attachment 2, Chapter II)

#### **5.4.1 Triennial Fire Protection Assessment**

*Criterion:*

*The site contractor conducts a triennial FPP assessment (or a series of more frequent assessments that when combined, are equivalent to the triennial assessment) that evaluates the full scope of the program. (DOE Order 420.1C, Attachment 2, Chapter II)*

The NTESS requirement to perform a comprehensive self-assessment of the FPP at least every three years is documented in PGM-003, Section 3.7. NTESS provided EA with a *Corporate Fire Protection Program Self-Assessment Plan FY13-FY15*, dated September 12, 2012, outlining the framework for conducting FPP self-assessments. However, NTESS has not conducted the self-assessment of the SNL/NM FPP. SFO previously identified this issue in February 2017. SNL/NM entered in the Assurance Information System the expected completion date of September 30, 2017, for conducting a self-assessment of the corporate fire protection program (CFPP). At the time of this EA assessment, NTESS had yet to complete a CFPP self-assessment. However, SFO approved an extension for NTESS to complete the CFPP self-assessment by September 28, 2018. Completion of the NTESS self-assessment of the FPP is a follow-up item identified in Section 8.0 of this report.

#### **5.5 Configuration Management**

EA reviewed the contractor's configuration management programs and processes to verify that they are adequate to ensure that fire protection systems designated as safety systems continue to meet safety basis requirements, and that changes are properly controlled. (DOE Order 420.1C, Attachment 2, Chapter II; DOE-STD-1073, *Configuration Management*)

##### **5.5.1 Configuration Management and Integration**

*Criteria:*

*The configuration management process adequately integrates the elements of fire protection system requirements and performance criteria, system assessments, change control, work control, and documentation control. (DOE Order 420.1C, Attachment 2, Chapter II)*

*Configuration management is used to develop and maintain consistency among system requirements and performance criteria, documentation, and physical configuration for the SSCs within the scope of the fire protection program. (DOE Order 420.1C, Attachment 2, Chapter II)*

PGM-003 requires a configuration control program to manage changes to fire protection-related elements, so that proposed changes do not adversely impact safety. EA verified the implementation of this requirement by reviewing approved equivalencies to fire protection system changes associated with ITM frequency adjustments that differ from NFPA codes and standards. Additionally, completed fire protection records of approval are periodically turned over to document control where they are stored in the FileNet Document Management System. Drawings provided on the 858EF Facility carbon dioxide systems and fire barriers were verified as current and consistent with the systems installed; however, as discussed in Section 5.3.1 of this report, EA identified inadequacies with the configuration management process in the ITM program.

The fire suppression system calculations of record that EA reviewed were not independently verified, dated, and approved, as required by NFPA 13, *Standard for the Installation of Sprinkler Systems*. NTESS does not have a formalized procedure or process for preparing design documentation and analyses consistent with the requirements of NFPA 13.

## 5.5.2 Change Control

### *Criteria:*

*Fire protection system design basis documentation and supporting documents are kept current using formal change control and work control processes. (DOE Order 420.1C, Attachment 2, Chapter II)*

*Changes to fire protection system requirements, documents, and installed components are formally designed, reviewed, approved, implemented, tested, and documented. (DOE Order 420.1C, Attachment 2, Chapter II; applicable NFPA codes and standards from the site-specific contract)*

EA reviewed the change process employed at the MicroFab Facility to keep the safety basis documentation up to date. The SA document is controlled through a formal management of change (MOC) process, which includes appropriate steps to review and approve proposed changes to the document. This process also validates the existing facility hazard classification and ensures that the controls identified to mitigate hazards in facilities, operations, and activities continue to provide adequate protection to the workers, the public, and the environment. EA reviewed six MOCs prepared during the past year and determined that these documents are adequate.

## 5.5.3 Configuration Management Conclusion

The configuration management process was generally adequate in the areas of records management, maintaining drawings, and the MOC process. However, configuration management weaknesses were identified related to the documentation of the FPP ITM program and the absence of a formal process for the preparation of design analyses and other design products consistent with DOE Order 420.1C requirements.

## 5.6 DOE Field Element Oversight

This section discusses EA's assessment of SFO's implementation of the oversight process and its major elements, specified in DOE Order 226.1B, *Implementation of Department of Energy Oversight Policy*, to ensure that SNL/NM's FPP activities, programs, and management systems are appropriately evaluated.

### *Criteria:*

*DOE field element line management has established and implemented effective oversight processes to evaluate the contractor's FPP and verify implementation (including compliance with requirements). (DOE Order 226.1B)*

*DOE field element staff are adequately trained and qualified to perform assigned oversight activities. (DOE Order 226.1B)*

*The DOE field element line oversight program includes written plans and schedules for planned assessments, focus areas for operational oversight, and reviews of the contractor's self-assessment of processes and systems. (DOE Order 226.1B, 4.b.(2))*

*Oversight processes are tailored according to the effectiveness of the contractor assurance systems, the hazards at the site/activity, and the degree of risk, giving additional emphasis to potentially high consequence activities. (DOE Order 226.1B, 4.b.(5))*

EA reviewed SFO's FPP oversight program and determined that SFO has effectively structured its line management oversight of NTESS's FPPs and fire protection safety systems at SNL/NM to adequately oversee fire protection safety systems and FPP safety management programs. The SFO program is

defined in SBMS 0804, *Policy: Sandia Field Office Oversight*, Rev. 2, dated June 2017; SBMS 0804.01.01, *SFO Oversight Plans, Schedules and Revisions*, Rev. 4, dated August 2017; and Sandia Field Office Crosscutting Procedure 1303.05, *Fire Protection Program*, Rev. 4, dated September 20, 2017. SFO has developed a comprehensive schedule, with well-written plans, to focus appropriate attention on FPP at SNL/NM in general, and the 858EF Facility specifically. The SFO FPE has effectively prioritized his reviews of both the nuclear-related FPPs and the non-nuclear facilities at SNL/NM, including the 858EF Facility. The SFO FPE actively assesses NTESS's Code 4879 Building and Fire Safety staff activities. The SFO FPE also actively participates in NTESS's Code 4879 weekly FPP staff meetings and a one-on-one biweekly meeting with his NTESS counterpart, the 4879 Manager, to discuss upcoming activities and resolution of open items. He assists in conducting FPP self-assessments, updates the fire protection material conditions report, maintains a list of impaired and out-of-service systems, reviews SNL/NM FPP documents, and provides input to monthly and quarterly reports. The SFO FPE performs periodic walkthroughs of SNL/NM facilities to evaluate implementation of the NTESS FPPs, with a focus on the safety of the SNL/NM nuclear facilities. As such, SFO requested that EA review the NTESS FPP in the non-nuclear MESA MicroFab 858EF Facility.

SFO has one trained and qualified FPE, who has successfully completed the NNSA technical qualification program. The SFO FPE is a professional engineer, an NFPA-certified fire protection specialist, a fire inspector II, and a fire plan examiner. In addition, he has been actively involved in continuing education programs for FPEs in the local region, including for SNL/NM and Los Alamos National Laboratory.

The SFO FPE performs reviews and recommends approval of SNL/NM FPP description documents, evaluations, and engineering equivalencies. In the assessments EA reviewed, the scope was well defined and included appropriate follow-up on prior assessment findings and reviews of the implementation of safety basis conditions of approval. The assessments included appropriate performance-based elements, such as walkdowns of portions of assessed systems and components, reviews of as-built drawings, interviews of engineering and operations personnel, reviews of surveillance test results, and reviews of any design modification packages and associated unreviewed safety question determinations.

SFO has adequately retained responsibilities for fire protection AHJ, BCO, and owner responsibilities for the following:

- Concurrence for all exemption requests to DOE Order 420.1C, to DOE technical standards, and to industry consensus codes and standards
- Concurrence for equivalency requests to DOE Order 420.1C
- Approval of equivalencies to specifications within DOE technical standards and to industry codes and standards, where acceptable options are not expressly provided in the standards
- Authority to override NTESS decisions, including the interpretation and application of DOE orders, guides, standards, mandatory codes and standards, and assigned responsibilities.

EA reviewed SFO's oversight of AHJ determinations and concluded that SFO is appropriately reviewing and, when required, challenging NTESS interpretations. As needed, based on AHJ reviews, SFO provides additional oversight based on the hazards of the activity and the degree of risk, adding emphasis to potentially high-consequence activities.

## **6.0 FINDINGS**

Findings are deficiencies 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. DOE line management and/or contractor organizations must develop and implement corrective action plans for EA assessment findings. Cognizant DOE managers must use site- and program-specific issues management processes and systems developed in accordance with DOE Order 227.1A to manage these corrective action plans and track them to completion. In addition to the findings, deficiencies that did not meet the criteria for a finding are listed in Appendix C, with the expectation from DOE Order 227.1A for site managers to apply their local issues management processes for resolution.

**Finding F-NTESS-1:** Contrary to requirements, the 858EF Facility Fire Hazard Analysis is not maintained current and the technical content and analysis of operations is inadequate (DOE Order 420.1C, Section 3.f(1) and PGM-003, Section 3.4).

**Finding F-NTESS-2:** Contrary to requirements, the fire suppression system piping and components classified as seismically qualified (category PC-2) do not meet system seismic interaction criteria because non-seismically qualified equipment is located above seismic qualified (category PC-2) equipment (DOE-STD-1021 and the MicroFab SA).

**Finding F-NTESS-3:** Contrary to the performance criteria in the SA, NTESS has not developed an analytical engineering bases document that adequately demonstrates fire suppression system performance capability.

## **7.0 OPPORTUNITIES FOR IMPROVEMENT**

EA did not identify any OFIs during the assessment.

## **8.0 ITEMS FOR FOLLOW-UP**

- Annual wildland fire protection engineering assessments. See Section 5.1.7.
- Completion of the NTESS self-assessment of the FPP. See Section 5.4.1.

## **Appendix A Supplemental Information**

### **Dates of Assessment**

Onsite Assessment:     February 19-23, 2018  
                                  March 19-23, 2018

### **Office of Enterprise Assessments (EA) Management**

William A. Eckroade, Acting Director, Office of Enterprise Assessments  
Thomas R. Staker, Director, Office of Environment, Safety and Health Assessments  
William E. Miller, Deputy Director, Office of Environment, Safety and Health Assessments  
C.E. (Gene) Carpenter, Jr., Director, Office of Nuclear Safety and Environmental Assessments  
Kevin G. Kilp, Director, Office of Worker Safety and Health Assessments  
Gerald M. McAteer, Director, Office of Emergency Management Assessments

### **Quality Review Board**

Steven C. Simonson  
John S. Boulden III  
Thomas R. Staker  
William E. Miller  
Michael A. Kilpatrick

### **EA Site Lead for Sandia National Laboratories**

Timothy F. Mengers

### **EA Assessors**

C.E. (Gene) Carpenter, Jr. – Lead  
Joseph J. Panchison  
Barry Snook

**Appendix B**  
**Key Documents Reviewed, Interviews, and Observations**

**Documents Reviewed**

- Letter from M. Hazen to P. Wagner, *Equivalency Request*, September 15, 2011
- Letter 11-0338-400288 from P. Wagner to M. Hazen, *Approval of Equivalency Request – Non-Nuclear Facilities: National Fire Protection Association 25 Visual Inspection Frequency*, December 16, 2011
- Letter from M. Smith to L. DeSerisy, *Support Agreement Between 377 Air Base Wing and Department of Energy (DOE)*, June 11, 2014
- Letter 703584 from J. Harrell to M. Hazen, *Approval of the Sandia Corporate Fire Protection Program and Proposed Building Code Official (BCO) and Authority Having Jurisdiction (AHJ)*, November 3, 2016
- Letter 726954 from J. Harrell to M. Hazen, *Approval of the Revised Sandia Corporate Fire Protection Program*, April 11, 2017
- Letter 714479 from D. Pellegrino to M. Hazen, *Assignment of Fire Protection Authority Having Jurisdiction (AHJ), Building Code Official (BCO), and Owner Responsibilities to Sandia Corporation (Sandia)*, March 13, 2017
- Letter 727795 from D. Pellegrino to M. Hazen, *Joint Assessment Review of the Sandia Corporation (Sandia) Corporate Fire Protection Program (CFPP) for the Sandia National Laboratories/New Mexico (SNL/NM) Site*, April 5, 2017
- Letter 726954 from J. Harrell to M. Hazen, *Approval of the Revised Sandia Corporate Fire Protection Program*, April 11, 2017
- Letter 729312 from J. Harrell to J. Clymo, *Approval of the Sandia National Laboratories/New Mexico Base Line Needs Assessment*, April 26, 2017
- Letter from J. Clymo to J. Harrell, *Joint Assessment Review of the Sandia Corporate Fire Protection Program (CFPP)*, June 5, 2017
- Letter from J. Clymo to J. Harrell, *Sandia National Laboratories/New Mexico Baseline Needs Assessment Equivalencies Request*, December 20, 2017
- Contract No. DE-NA0003525, *H-25 Asset Management Requirements*, 12/27/2017
- ASRP-OPS-3.22.2017-726496, *NNSA/SFO Fire Protection Joint Assessment Review for the Sandia National Laboratories, New Mexico Site*, February 2017
- Support Agreement FB4469-14271-610, *Annex A Specific Provisions - Fire Protection*, 9/28/2014
- Evaluation 55435, *FMOC\_FY17\_Q2\_Building and Fire Safety\_NNSA/SFO Assessment Sandia NM CFPP-Assessment# ASRP-OPS-3.22.2017-726496*, April 14, 2017
- Equivalency Evaluation, *Building Safety and Assurance (4879)*, August 2011
- Equivalency Request, *NFPA 1710 Emergency Medical Response Times*, December 18, 2017
- Equivalency Request, *NFPA 1710 Structural Firefighting Staffing and Response Times*, December 18, 2017
- MN471017, Issue H, *Safety Basis Manual*, October 12, 2017
- Rev. 4.6, *MESA MicroFab Safety Assessment*, December 2016
- 04-3027.100, Rev. 1, *Title III Final Fire Hazards Analysis-Microsystems and Engineering Sciences (MESA) Project Microfabrication Facility (Building 858 East) and Central Utilities Building No. 1 (Building 858J)*, May 23, 2006
- *Building 858EF Pre-Incident Plan*, December 19, 2016
- Facilities Management and Operations Center, Rev. 1, *Sandia National Laboratories, New Mexico: Emergency Response Baseline Needs Assessment*, October 2016

- Facilities Management and Operations Center, Rev. 0, *Sandia National Laboratories, New Mexico: Emergency Response Compliance Assessment*, December 2016
- *Corporate Fire Protection Program Self-Assessment Plan FY13-FY15*, September 17, 2012
- PGM-003, *Corporate Fire Protection Program*, 2/23/2017
- POL-001, *Corporate Fire Protection Program Policy*, 7/19/2016
- FAC100.2.4, *Manage Fire Protection Requirements*, September 20, 2013
- PCD-037, *Performing Fire Protection Assessments: Overview*, 7/5/2017
- PCD-039, *Wildland Fire Management Plan for SNL/NM*, 2/22/2018
- PCD-042, *Maintaining Fire Protection Systems*, 6/26/2015
- PCD-090, *858 MESA Fire Alarm and Fire Protection Systems Modification, Inspection, Testing, and Maintenance*, 2/4/2015
- PCD-109, *Development and Maintenance of Fire Hazards Analysis*, 2/5/2018
- PCD-110, *Sandia National Laboratories Hydrant Flow Test*, 1/10/2018
- PCD-111, *Performing Fire Protection Assessments: Facility Walk-through*, 2/5/2018
- PCS.077, Rev. 10, *Fire Protection Inspection, Testing and Maintenance*, 12/21/2016
- Form FRM-349, *Hydrant Flow Test Report*, 3/20/2018
- Form FRM-056, *Fire Protection Systems Summary*
- Form FRM-057, *Fire Protection ENDSS+ Life Safety Survey*, 9/21/2016
- Hydraulic Calculations, *MicroFab Facility Bid Documents*, December 9, 2002
- Submittal 15310-03, *Product Data/Hydraulic Calcs. (B,S)*, October 9, 2003
- WO# 20160119775, *Sprinkler System PM Checklist-Quarterly (Feb, Aug)-Building 858EF*, 2/22/2016
- WO# 20160351615, *Sprinkler System PM Checklist-Quarterly (Feb, Aug)-Building 858EF*, 8/24/2016
- WO# 20160242885, *Sprinkler System PM Checklist-Semiannual (May)-Building 858EF*, 7/30/2016
- WO# 20170018469, *Sprinkler System PM Checklist-Annual (Nov)-Building 858EF*, 11/11/2016
- WO# 20170137527, *Sprinkler System PM Checklist-Quarterly (Feb, Aug)-Building 858EF*, 2/27/2017
- WO# 20170299019, *Sprinkler System PM Checklist-Semiannual (May)-Building 858EF*, 6/13/2017
- WO# 20170299019, *Sprinkler System PM Checklist-Annual (Nov)-Building 858EF*, 6/8/2017
- WO# 20170455541, *Sprinkler System PM Checklist-Quarterly (Feb, Aug)-Building 858EF*, 8/29/2017
- WO# 20180007580, *Sprinkler System PM Checklist-Annual (Nov)-Building 858EF*, 4/8/2017
- PM 127697, *858EF Fire Damper Building Record*, Print Date 3/9/2018
- Corrective Analysis 46876, *Fire Damper Documentation as Per NFPA 80*, September 26, 2016
- Sales Order 40603, *Flame Retardant Plastic Film*, 11/8/2017
- SBMS 0804, Rev. 2, *Policy: Sandia Field Office Oversight*, June 2017
- SBMS 0804.01.01, Rev. 4, *SFO Oversight Plans, Schedules and Revisions*, August 2017
- Sandia Field Office Crosscutting Procedure 1303.05, Rev. 4, *Fire Protection Program*, September 20, 2017

## Interviews

Fire Marshal

Fire Protection Engineer (Wildland Fire Plan)

Fire Protection Engineer (Fire Protection Systems ITM)

Fire Protection Engineer (Building Assessments)



Fire Protection Engineer (BNA/Emergency Response)  
Fire Protection Technician  
858EF Team Lead Fire Protection Systems  
858EF Building Code Official  
Manager Sandia Health Care  
Emergency Management Team Lead Emergency Response  
Safety Basis Owner  
858EF Safety Manager

### **Observations**

858EF Walkthroughs (2)  
858EF Flow Test  
Tour - Sandia Health Clinic  
Tour - Sandia Mobile Command Center  
Infrastructure Meeting  
Fire Protection Weekly Meeting  
SFO/SNL Fire Protection Meeting  
858EF Overview Presentation

## **Appendix C Deficiencies**

Deficiencies that did not meet the criteria for a finding are listed below, with the expectation from DOE Order 227.1A for site managers to apply their local issues management processes for resolution.

- The combustible control program does not meet DOE Order 420.1C, Attachment 2, Chapter II, Section 3.d(1)(d), which requires comprehensive written fire protection criteria and procedures be established for the use and storage of combustible, flammable, and hazardous materials.
- NTESS FPEs are not performing required ITM reviews, contrary to PCD-037, Sections 3.1.2 and 3.2.
- PCD-037 and FRM-056 do not provide sprinkler system assessment criteria that ensures that obstructions will not affect full required sprinkler coverage as required by PCD-111, Section 3.1.
- The facility fire protection design configuration deviates from the requirements identified in DOE Order 420.1C related to fire-rated barriers. The subfab basement ceiling penetrations were, in some cases, open with no penetration seal or only partially sealed with no contiguous penetration sealing material.
- In some areas of the subfab basement, fire suppression sprinkler obstructions were noted that would prevent full required sprinkler coverage. Ceiling-level sprinklers were observed to be obstructed by dense piping and ducts, thereby inhibiting the full sprinkler coverage discharge pattern required by NFPA 13.
- Inconsistencies exist with water-based fire suppression system records, and results of fire damper inspection and tests are not documented, contrary to the requirements of DOE Order 420.1C, which state that a documented configuration management program must be established and implemented that ensures consistency among system requirements and performance criteria, system documentation, and physical configuration of the systems within the scope of the program to include system design and test documentation.