

**Office of Enterprise Assessments
Assessment of the Waste Isolation Pilot Plant
Fire Protection Program**



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Acronyms

AIB	Accident Investigation Board
BNA	Baseline Needs Assessment
CBFO	Carlsbad Field Office
CFR	Code of Federal Regulations
CH	Contact Handled
CRAD	Criteria and Review Approach Document
DOE	U.S. Department of Energy
DSA	Documented Safety Analysis
EA	Office of Enterprise Assessments
EBA	Escape Breathing Apparatus
EPHA	Emergency Preparedness Hazard Assessment
FHA	Fire Hazards Analysis
FPE	Fire Protection Engineer
FPP	Fire Protection Program
FSR	Filtered Self-Rescuer
FSS	Fire Suppression System
HEPA	High Efficiency Particulate Air
ITM	Inspection, Test, and Maintenance
JON	Judgment of Need
LCO	Limiting Condition for Operation
MPFL	Maximum Possible Fire Loss
MRT	Mine Rescue Team
MSHA	Mine Safety and Health Administration
NFPA	National Fire Protection Association
NIOSH	National Institute of Occupational Safety and Health
NWP	Nuclear Waste Partnership, LLC
OFI	Opportunity for Improvement
SCSR	Self-Contained Self-Rescue
SSC	Structure, System, or Component
SSO	Safety System Oversight
STD	Standard
TRU	Transuranic
TSR	Technical Safety Requirement
UG	Underground
USQ	Unreviewed Safety Question
WHB	Waste Handling Building
WIPP	Waste Isolation Pilot Plant

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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 a targeted assessment of the Waste Isolation Pilot Plant (WIPP) fire protection program. EA identified fire protection as a targeted assessment area for DOE independent oversight in a memorandum, *Independent Oversight of Nuclear Safety – Targeted Review Areas Starting in FY 2013*, dated November 6, 2012. EA has also made it one of its highest priorities to provide the necessary independent oversight to ensure that the recovery of WIPP is performed safely and in accordance with current requirements to ensure the health and safety of the workers, the public, and the environment.

This assessment addressed both the contractor, Nuclear Waste Partnership, LLC (NWP), and DOE Carlsbad Field Office (CBFO) oversight to determine their effectiveness in implementing key elements of the fire protection program. These elements include program documentation, pre-incident plans, the exemption and equivalency process, combustible control, fire hazards analysis, and the inspection, test, and maintenance program. The assessment further evaluated the fire hazards analysis and its integration with the documented safety analysis, technical safety requirement surveillance and testing, and configuration management aspects of the fire protection program and related systems and components. EA also evaluated the fire protection elements of mine safety.

In most cases, NWP has effectively established and implemented fire protection controls for reducing the risk associated with fire at the WIPP. The fire protection engineers were knowledgeable of the fire protection program and the supporting fire systems. They exhibited a high level of knowledge regarding the inherent risks associated with fire and were actively engaged in supporting several project upgrades. These upgrades include a wireless notification system and automatic fire suppression for high fire-load areas in the underground, a public address system, and fire alarm system. Additionally, EA considers the vehicle hazard analysis checklists for the mine vehicles a best practice for evaluating the need for fire suppression.

EA identified two significant weaknesses during this assessment. First, NWP does not provide two properly maintained and marked escapeways from each underground working place to the surface as required by the Mine Safety and Health Administration. The critical elements for mine escape and evacuation, such as pre-planned escape routes and designated, marked escape routes, were inadequate to ensure that miners can navigate in smoke-filled entries. WIPP has sufficient shafts and drifts to fully comply with the MSHA requirements, but the escape routes established in WP 12-ER.25, *Underground Escape and Evacuation Plan*, do not provide two separate escapeways positioned so that damage to one does not reduce the effectiveness of the others. In addition, several underground escapeways were marked in a way that did not properly identify the appropriate escape route. These deficiencies in the *Underground Escape and Evacuation Plan*, escape routes, and marking of emergency escapeways could limit the ability of underground personnel to evacuate the mine successfully during an emergency.

Second, the water supply and distribution for fire suppression is not reliable and adequate. The exterior underground water piping that supplies the facility's safety-significant fire suppression systems is degraded, with 11 pipe failures since 2008. Further, the fire system impairment program is lacking key elements adding to the concern of system operability. The most recent pipe failure, in October 2015, involved a 6-inch underground lead-in supplying firewater to the Waste Handling Building; this pipe has not yet been scheduled for repair. The suspected cause of degradation, based on interviews with both

NWP and DOE fire engineers, is the migration of airborne salt into the ground, resulting in corrosion from the exterior surface of the pipe to the inside. Generally, EA observed that NWP has taken only limited actions and given insufficient priority to address the replacement of existing degraded pipe and repair of failed piping. There has been no engineering analysis to evaluate the health and wellness of the underground firewater distribution system, which represents a significant vulnerability and increased risk associated with supplying the required water in case of a fire.

The CBFO fire protection subject matter expert is qualified and knowledgeable of the site fire protection systems but is not adequately engaged in providing oversight of the contractor inspection, test, and maintenance programs. CBFO conducts comprehensive periodic reviews of the NWP fire protection program, but does not adequately track identified issues and corrective actions to closure.

In summary, the WIPP fire protection program has made some improvements, including upgrades designed to mitigate risks associated with fire in the underground mine and progress on corrective actions related to the 2014 fire incident and subsequent DOE accident investigation. Several key program documents have been developed and are awaiting review and approval by CBFO. However, deficiencies in the provisions for mine evacuation and the reliability of the safety-significant firewater distribution system represent significant vulnerabilities and require management attention to ensure that they are addressed to support resumption of waste emplacement operations.

Office of Enterprise Assessments
Assessment of the Waste Isolation Pilot Plant
Fire Protection Program

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 a targeted assessment of the Waste Isolation Pilot Plant (WIPP) fire protection program (FPP) to evaluate the Nuclear Waste Partnership, LLC (NWP) implementation of program requirements and the adequacy of controls designed to reduce the risk resulting from a fire or explosion at nuclear facilities. This assessment also evaluated the Carlsbad Field Office (CBFO) oversight of the FPP. This targeted assessment evaluated fire protection elements for benchmarking the program's effectiveness and was conducted within the broader context of an ongoing program of targeted assessments of FPPs across the DOE complex at hazard category 1, 2, and 3 nuclear facilities. EA conducted the onsite portions of this review February 1-5 and February 29 – March 4, 2016.

2.0 SCOPE

This assessment evaluated the effectiveness and implementation of the WIPP FPP established by NWP, as well as CBFO's oversight of the FPP, focusing on the Waste Handling Building (WHB) and the underground (UG) mining equipment and operations. This assessment evaluated each organization to ensure that the necessary and appropriate policies and procedures are in place to minimize the fire risk. It also evaluated key FPP elements, including the baseline needs assessments (BNAs), pre-fire plans, the exemption and equivalency process, the fire impairment and hot work permit processes, the combustible control program, the fire hazards analysis (FHA), and the National Fire Protection Association (NFPA) inspection, test, and maintenance (ITM) program. EA reviewed key facility documents, including the FHA/documented safety analysis (DSA), technical safety requirement (TSR) surveillance and testing procedures, and self-assessments. EA also evaluated the effectiveness of corrective actions resulting from the DOE accident investigation board (AIB) after the fire incident on February 5, 2014, involving a salt haul truck and subsequent radiological release. Programmatic elements include: pre-incident plans, exemption and equivalency process, combustible controls, fire hazards analysis, configuration management and, the inspection, test, and maintenance program.

3.0 BACKGROUND

NWP, the WIPP management and operating contractor, is an AECOM-led entity with partner B&W Technical Services Group, managing WIPP under a five-year contract. NWP is responsible for site waste handling operations, mine construction, and operating services. NWP performs the unloading of the Nuclear Regulatory Commission certified Type B shipping containers, transfer of contact-handled (CH) and remote-handled waste containers to the UG, and emplacement into a disposal location, as well as maintenance of the surface and UG facilities. The responsibility for safe operation of WIPP lies with facility line management, which includes facility operations for surface structures, systems, or components (SSCs); UG operations integration for UG SSCs; and waste operations for waste handling equipment.

WIPP is owned by DOE, which provides oversight of WIPP operations through CBFO. CBFO coordinates the transuranic program at waste-generating sites, national laboratories, and other participants

for permanent disposal of defense-generated transuranic (TRU) waste. Under the Assistant Secretary for Environmental Management, CBFO manages the national TRU program and the WIPP site from offices in Carlsbad, New Mexico. The CBFO Office of Operations Oversight includes four divisions providing WIPP oversight: safety (nuclear and emergency management), facility oversight (Facility Representatives), engineering (safety system oversight), and environmental protection.

In response to the two accidents at WIPP in early 2014, EA established a plan for oversight of the NWP and CBFO recovery and restart actions with a high priority on ensuring the safety of the workers, the public, and the environment. WIPP operations were limited at the time of the review due to the restart effort. This reduced mode of operations limited the performance aspects of the EA assessment for evaluating key programs, including the implementation of combustible controls.

4.0 METHODOLOGY

The DOE independent oversight program is 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.

The review followed the process described in the *Plan for the Office of Enterprise Assessments Activity Targeted Review of the Fire Protection Program at the Waste Isolation Pilot Plant*, dated December 17, 2015. The reviewed elements are based on selected objectives and criteria from EA Criteria and Review Approach Document (CRAD) 45-34, Rev 1, *Fire Protection*. As identified in the assessment plan, this assessment considered requirements related to fire protection listed in 10 CFR 851, *Worker Safety and Health Program*; DOE Order 420.1C, *Facility Safety*; and applicable NFPA codes and standards. EA compared NWP performance against 10 CFR 851, applicable Mine Safety and Health Administration (MSHA) regulations, and NFPA and other consensus standards. MSHA regulations are implemented by WP 15-GM.02, *WIPP Worker Safety and Health Program Description Document*, which implements 30 CFR, *Mine Safety and Health Administration*, Parts 47, 48, 49, 57, and 62, *Safety and Health Standards-Underground Metal and Nonmetal Mines*. EA also used selected elements of CRAD 45-21, *Feedback and Continuous Improvement Inspection Criteria and Approach – DOE Field Element*, to collect and evaluate the effectiveness of CBFO’s oversight of the FPP.

EA examined key documents, such as system descriptions, work packages, procedures, manuals, engineering analyses, policies, training and qualification records, and numerous other documents. EA also conducted interviews of key personnel, including both the contractor and DOE, responsible for developing and executing the FPP; observed surveillance testing of sprinkler systems; and walked down the underground and WHB, focusing on administrative controls in the areas of combustible loading and mine evacuation. 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, are provided in Appendix B. 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.

EA has not conducted a recent fire protection assessment of the WIPP facility and therefore had no previous items for follow-up during this assessment.

5.0 RESULTS

5.1 Fire Protection Program

Criteria

A documented FPP that includes elements and requirements for design, operations, emergency response, fire analysis and assessments, wildland fire, and specific fire protection criteria must be developed, implemented, and maintained by the contractor. The FPP shall include requirements for life safety and means of egress for building occupants. (DOE Order 420.1C, DOE-STD-1066-2012)

Pre-incident strategies, plans and standard operating procedures must be established to enhance the effectiveness of manual fire suppression activities. (DOE Order 420.1C)

A process must be established for developing and requesting approval from the DOE AHJ [authority having jurisdiction] for equivalencies and exemptions to fire protection requirements. (DOE Order 420.1C)

Comprehensive, written fire protection criteria and procedures must be established and include use and storage of combustible, flammable, radioactive and hazardous materials. (DOE Order 420.1C)

A documented comprehensive self-assessment of the fire protection program is performed by the DOE site office and the facility contractor at least every three years, or at a frequency with appropriate justification approved by the DOE head of field element. (DOE Order 420.1C)

General Requirements and Documentation

The FPP at NWP provides a level of fire protection consistent with the industrial risks as required by DOE Order 420.1C. It includes the fire protection procedures, technical criteria, FHAs, and personnel that ensure achievement of DOE objectives relating to fire safety. NWP's FPP is described in WP 12-FP.01, *WIPP Fire Protection Program*. At the time of this assessment, several key documents were awaiting final approval from CBFO, including the FPP plan, the baseline needs assessment (BNA), the WHB FHA, and an equivalency and exemption for the UG. EA identifies these as items for follow-up in Section 8.0.

Pre-Incident Plans

Pre-incident plans currently reside with the Emergency Management group, which has an established procedure, WP 12-FP3004, *WIPP Fire Department Pre-Incident Plans*, that contains adequate controls to ensure that the pre-incident plans are current and readily available for reference during an emergency response.

However, the pre-incident plans for the UG and WHB do not include the following information as required by WP 12-FP3004, Section 1.1 and NFPA 1620, *Standard for Pre-Incident Planning*, Section 5.3.1 (**Deficiency**):

- The WHB pre-incident plan specifies the occupant limit as moderate during day shift, low at nights, and moderate during waste operations. It does not specify the occupancy limit number as the procedure requires.

- The UG and WHB plans do not make emergency contact information readily available in order to minimize delays in performing emergency operations and to ensure that the fire scene is safe for responders.
- The UG pre-incident plan form does not indicate the fire suppression systems (FSS) installed in the UG, including the two 500-pound automatic dry chemical FSS protecting the refueling station. This issue is similar to configuration management concerns that EA identified in November 2015, as reported in *Office of Enterprise Assessments Review of Waste Isolation Pilot Plant Engineering and Procurement Processes*.

The completeness of the plans is necessary to effectively support facility emergencies and ensure protection of occupants and responding personnel.

Exemption and Equivalency Process

NWP has submitted to CBFO for approval one exemption request and one equivalency request for the UG, as a result of the salt truck fire and subsequent August 2015 DOE Fire Protection Workshop. EA reviewed these documents and observed that the technical basis for an alternative method of compliance was adequate. However, the FPP has no documented process for developing and requesting approval of exemptions and equivalencies as required by DOE Order 420.1C, Attachment 2, Chapter II, Section 3.d (2) (c) (**Deficiency**). As noted, EA will follow up on these documents in future assessment activity.

FPP Self-Assessments

EA reviewed WP 12-FP.01, which establishes the minimum FPP elements for conducting FPP self-assessments consistent with the DOE-STD-1066-2012, *Fire Protection*. EA verified that NWP FPP self-assessments are conducted at least every three years and under the supervision of a fire protection engineer (FPE) in accordance with DOE requirements. EA reviewed the two most recent NWP FPP self-assessments to determine whether they evaluated key elements of the FPP to verify the adequacy of the program. EA concluded that the self-assessments are comprehensive but do not always address all key elements of the FPP including the fire system impairment and emergency response programs.

Facility/Building Fire Safety Assessments

NWP had no records of facility/building fire safety assessments for the WHB or UG, as required annually by DOE Order 420.1C Attachment 2, Chapter II, Section 3.f (2) (**Deficiency**).

Fire Hazards Analysis

EA reviewed WIPP-023, *Fire Hazard Analysis for the Waste Isolation Pilot Plant*, and concluded that it includes an adequate assessment of the risk from fire and related hazards in relation to installed fire safety features. The FHA facility descriptions for the WHB, mineshafts, and UG facilities are consistent with results of walkdowns performed as part of this review. EA also verified that all the minimum criteria were established in WP 12-FP.01 and that the FHA is maintained current by qualified FPEs.

Although the FHA is comprehensive, EA identified two issues:

- The FHA refers to a 2008 maximum possible fire loss (MPFL) value for the WHB as \$38 million. The DOE threshold value requiring redundant fire systems is \$50 million. The FHA states: “The programmatic impact in terms of monetary loss indicates that the worst case fire costs and recovery costs and resumption of operations after the salt haul truck fire incident are estimated to be

approximately \$242 million.” Therefore, the MPFL value of \$38 million does not represent the most conservative estimate when considering programmatic impacts.

- DOE Order 420.1C, Attachment 2, Chapter II, Section 3.d (1) (h) requires written criteria and procedures to implement facility FHAs. NWP does not have a procedure for conducting FHAs (**Deficiency**).

EA also reviewed vehicle hazard analysis checklists for UG mining vehicles as established in NFPA 122, *Standard for Fire Prevention and Control in Metal/Nonmetal Mining and Metal Mineral Processing Facilities*. The NWP hazard analysis consists of five phases that are comprehensively used to determine whether a vehicle requires FSS(s), the existing system is satisfactory or needs replacement, or a second system is required. The checklist provides for a comprehensive five-phase analysis: identifying the potential for fire, assessing the consequences of fire, determining the need for fire protection, and selecting fire suppression options and the appropriate fire suppression system hardware. EA considers the vehicle hazard analysis checklists to be a best practice for evaluating the need for fire suppression on mine vehicles.

Combustible Control Program

Combustible control programs reduce the risk associated with fire by establishing minimum criteria for fuel loading. EA’s review of the implementation of combustible controls was limited due to the reduced mode of operations and consisted of evaluating site procedures.

EA reviewed three combustible control procedures and determined that they adequately establish the combustible control program for the WIPP site, but noted discrepancies in the combustible control fuel package limits and separation distances. EA also reviewed daily and weekly combustible control inspections performed February 22-28, 2016, in the UG and concluded that inspections were complete, with appropriate reviews and approvals.

EA recognizes that the ongoing revision to the WIPP DSA significantly affects the administrative controls for managing combustibles and will address the procedural discrepancies. EA has identified this item for follow-up.

Hot Work Program

The FPP includes a documented hot work program. EA reviewed WP 12-FP3002, *Hot Work Permits*, which describes the process for developing permits for temporary hot work activities and designated hot work areas. At the time of this review, no hot work activities were ongoing in the WHB or the UG, so EA limited its review to evaluating the hot work procedure and the requirements established in the FPP.

The procedure references NFPA 51B, *Standard for Fire Prevention During Welding, Cutting and Other Hot Work*, and the FPP (WP 12-FP.01) for developing the process. Although WP 12-FP3002 includes most requirements established in the FPP and NFPA 51B, it does not include verification that a portable fire extinguisher is available at the hot work area and that flammable and combustible materials are removed out to a radius of at least 35 feet (**Deficiency**).

Fire Protection System Impairments

EA found that NWP’s procedure for managing fire system impairments, WP 12-FP3001, *Fire Protection Impairment*, is adequate for managing planned impairments, but does not address controlling unplanned

and emergency impairments as required by DOE Order 420.1C, Attachment 2, Chapter II, Section 3.d (1) (f) (**Deficiency**).

EA also reviewed the active impairment permit list and observed two emergency fire system impairments. First, the six-inch lead-in pipe supplying firewater from the north side of the WHB was impaired as a result of a pipe failure in October 2015. NWP has not documented compensatory measures or established a timely repair commensurate with this increased risk (see Section 5.3, under Fire Water Supply and Distribution).

The second emergency impairment, involving the safety significant diesel firewater pump, occurred on March 3, 2016, while EA was on site. Although the pump manufacturer had informed NWP of a possible head gasket failure, NWP had neither a fire system impairment nor a non-conformance report to document the deficient condition. Despite the warning and potential unsafe condition, site operations performed WP 12-FP5114, *Annual Diesel Fire Pump Flow Test, 45-G-602*, which resulted in a significant pump failure and immediate termination of the test.

An effective impairment program is essential to ensure prompt attention to resolving deficiencies that involve fire suppression and passive fire protection features that mitigate risks associated with fire. EA concluded that fundamental elements of the fire impairment program had not been implemented.

Corrective Actions from the Salt Truck Fire AIB Report

On February 5, 2014, an underground mine fire involving an EIMCO salt truck occurred at WIPP. An AIB, appointed by DOE, investigated the incident in accordance with DOE Order 225.1B, *Accident Investigations*. The AIB identified ten contributing causes to this accident and provided conclusions that resulted in 35 judgments of need (JONs).

The Records Management group gave EA an overview of the tracking and recording of actions associated with the JONs. NWP has developed 75 corrective actions to address JONs related to fire protection and to support the restart efforts for WIPP. As of February 25, 2016, NWP had submitted 73 of the 75 corrective actions for CBFO review, 46 of which have been accepted. Of the two not submitted, one action is not due and the other was rejected by NWP management.

EA concluded that the closure packages were well organized and the requests for evidence files were timely. However, some closure packages were marked as completed before the supporting documents had been approved and revised. EA identified this as an item for follow-up.

5.2 Fire Protection Elements of Mine Safety

Fire protection operations at WIPP must integrate the applicable requirements of the MSHA with DOE orders, technical standards, administrative controls, and other hazard controls. EA assessed the integration of mine safety fire protection standards into site-specific requirements for three elements of mining:

- Systems for emergency escape and evacuation from UG workings
- The availability and use of emergency escape respirators
- Emergency communications and alarms in the UG.

Mine Evacuation

Escape and evacuation from underground workings in the event of a mine fire or other emergency is vital

to the safety of underground miners. According to research conducted by the National Institute for Occupational Safety and Health (NIOSH), the critical elements of mine escape and evacuation include pre-planned escape routes, designated escape routes marked so that miners can navigate in smoke-filled environments, and miners' routine participation in drills and exercises that simulate potential emergency conditions. EA reviewed the processes and procedures for underground escape and evacuation at WIPP to assess the adequacy of escape and evacuation plans, and the results of drills and exercises.

Criteria

Every mine must have two or more separate, properly maintained escapeways to the surface from the lowest levels which are so positioned that damage to one shall not lessen the effectiveness of the others. (30 CFR §57.11050)

Escape routes must be inspected at regular intervals and maintained in safe, travelable condition; and marked with conspicuous and easily read direction signs that clearly indicate the ways of escape. (30 CFR §57.11051)

Every mine must have a specific escape and evacuation plan and revisions thereof suitable to the conditions and mining system of the mine. Copies of the plan and revisions thereof shall be posted at locations convenient to all persons on the surface and underground. The plan shall be updated as necessary and shall be reviewed jointly by the operator and the Secretary or his authorized representative at least once every six months from the date of the last review. The plan shall include:

(a) Mine maps or diagrams showing directions of principal air flow, location of escape routes and locations of existing telephones, primary fans, primary fan controls, fire doors, ventilation doors, and refuge chambers. Appropriate portions of such maps or diagrams shall be posted at all shaft stations and in underground shops, lunchrooms, and elsewhere in working areas where persons congregate;

(b) Procedures to show how the miners will be notified of emergency;

(c) An escape plan for each working area in the mine to include instructions showing how each working area should be evacuated. Each such plan shall be posted at appropriate shaft stations and elsewhere in working areas where persons congregate;

(d) A firefighting plan;

(e) Surface procedure to follow in an emergency, including the notification of proper authorities, preparing rescue equipment, and other equipment which may be used in rescue and recovery operations; and

(f) A statement of the availability of emergency communication and transportation facilities, emergency power and ventilation and location of rescue personnel and equipment. (30 CFR §57.11053)

Mine evacuation drills shall be held at least every six months to assess the ability of all persons underground to reach the surface or other designated points of safety within the time limits of the self-rescue devices that would be used during an actual emergency. The evacuation drills shall be held for each shift at some time other than a shift change and involve all persons underground; involve activation of the fire alarm system; and include evacuation of all persons from their work areas to the surface or to designated central evacuation points. (30 CFR §57.4361)

On January 7, 2016, NWP issued WP 12-ER.25, *Underground Escape and Evacuation Plan*, to provide information regarding escape and evacuation of the mine during an emergency, addressing the requirements of 30 CFR §57.11053. The plan focuses on UG escape and evacuation protocols in accordance with WIPP emergency plans and procedures that address firefighting, emergency notifications, site emergency response, emergency equipment, and mutual aid; Figure 1 of the plan is the Underground Escape and Evacuation Map.

The plan addresses the required elements and refers to other WIPP procedure documents that provide additional details on firefighting, surface procedures, and notifications. The plan is posted in appropriate UG areas. WIPP has sufficient shafts and drifts to fully comply with the MSHA requirements, but the escape routes established in the plan do not provide two separate escapeways positioned so that damage to one does not reduce the effectiveness of the others as required by 30 CFR §57.11050. The plan for escape from workplaces near panel areas 1 through 7 designate the E-140 drift as the primary escapeway from the panels with exit through the Waste Shaft. The plan designates the secondary escape route from these panel areas as E-300 drift (if E-140 drift is blocked and impassable) to a point past the E-140 drift blockage, and then proceeding into E-140 drift to the Waste Shaft and exiting from the mine. EA noted that both the primary and secondary escapeways use the Waste Shaft for exiting from the mine. Similarly, for panel 8, the escape plan uses the W-30 drift as the primary escapeway, with exit through the Salt Shaft, and designates the secondary escape route as W-170 drift (if W-30 drift is blocked and impassable) to a point past the W-30 drift blockage then also proceeding to the Salt Shaft. The designation of only these two exit shafts is of increased significance when considering the impact of UG fires near these shafts, as described in several scenarios in the FHA and recently approved DSA. In those scenarios, workers in these panel areas would have no way out of the mine if they followed the specific instructions and routes in the plan. This situation is contrary to the requirement for two separate escapeways from the working place to the surface.

EA observed a limited number of UG areas to assess the implementation of the 30 CFR §57.11051 requirement that escape routes be inspected at regular intervals; maintained in safe, travelable condition; and marked with conspicuous and easily read direction signs that clearly indicate the ways of escape. Access to some UG areas was limited due to a safety pause and could not be evaluated for escapeway markings. Although significant improvement was evident in the visibility of escapeway markings, EA noted a number of inconsistencies between the plan and the actual UG markings in the S-90 drift from Q Room to W-170 drift and in E-140 drift from the intersection of the N-940 and N-1100 drifts (see **Finding F-WIPP-01**).

For example, the plan identifies S-90 as the secondary escapeway from Q Room area by traveling from Q Room toward W-170 to the Salt Shaft in E-0 drift. To properly mark this area in accordance with the escape and evacuation plan, red reflectors should be visible to a person traveling in this direction; however, there were no red reflectors in this travel direction. Further, the S-90 drift was marked with green reflectors, indicating that it was a primary escapeway from W-170 traveling towards Q Room and the Air Intake Shaft. This marking is significant because the Air Intake Shaft is not part of either the primary or secondary escapeway, and miners are instructed to use the Air Intake Shaft for escape to the surface only if specifically directed to do so by authorized personnel. Other similar inconsistencies were observed in the SDI area.

In summary, while sufficient shafts and drifts exists, NWP's *Underground Escape and Evacuation Plan* does not provide two separate escapeways from all working places in the mine, and deficiencies in the marking of escapeways underground are critical life safety issues.

Emergency Escape Respirator Program

Critical equipment for miners' protection underground includes emergency escape respirators. WIPP employs MSA model W65 filter self-rescuers (FSRs) carried by workers, supplemented with Ocenco escape breathing apparatus (EBA) 6.5 self-contained self-rescue (SCSR) units stored at various locations underground. The MSA FSRs are lightweight devices that workers are intended to carry at all times underground to protect them from carbon monoxide in case of a fire. The Ocenco SCSRs provide the wearer with a closed-circuit source of oxygen and isolate the wearer from irrespirable atmospheres from a fire. EA reviewed the UG storage and maintenance of the Ocenco SCSR units.

Criteria

Mines are required to provide a 1-hour self-rescue device approved by MSHA and National Institute of Occupational Safety and Health (NIOSH) under 42 CFR Part 84 shall be made available by the operator to all personnel underground. Each operator shall maintain self-rescue devices in good condition. (30 CFR §57.15030)

Respirators for mine rescue or other emergency use in mines requires that NIOSH and the Mine Safety and Health Administration (MSHA), U.S. Department of Labor, jointly review and issue certifications for respirators used for mine emergencies and mine rescue, including any associated service-life plans, users' manuals and other supporting documentation. Each certification for a respirator designed for mine rescue or other emergency use in mines shall include, as a condition of approval, any use limitations related to mine safety and health. (42 CFR §84.3)

EBA 6.5 SCSRs must be inspected daily if carried and inspected every 90 days if stored underground. (Ocenco Instruction Manual for the EBA 6.5 SCSR, Manual Number NH13747)

In the October 2015 *Review of Mine Safety, Stabilization, and Habitability at the Waste Isolation Pilot Plant*, EA observed that records showed that stored SCSRs were not inspected at 90-day intervals but at intervals that may exceed 130 days. Accordingly, EA issued a finding that NWP did not inspect SCSRs stored UG in accordance with the Ocenco EBA 6.5 Users' Manual, as approved by NIOSH, in accordance with 42 CFR Part 84. EA followed up on this issue by examining and inspecting SCSRs at several UG locations and reviewed inspection records for two SCSR storage locations. This examination showed that inspections were being conducted at 90-day intervals. All SCSRs examined met the inspection criteria established by Ocenco and approved by NIOSH.

Underground Alarms and Communication Systems

Criteria

A fire alarm system capable of promptly warning every person underground must be provided and maintained in operating condition. If persons are assigned to work areas beyond the warning capabilities of the system, provisions shall be made to alert them in a manner to provide for their safe evacuation in the event of a fire. (30 CFR §57.4363)

A suitable communication system must be provided at the mine to obtain assistance in the event of an emergency. (30 CFR §57.18013)

Telephones or other two-way communication equipment with instructions for their use must be provided for communication from underground operations to the surface. (30 CFR §57.20032)

The salt truck fire AIB reported that communication problems (e.g., unclear announcements) during the evacuation and the complexity of the alarm and communication system contributed to confusion throughout the mine. The AIB cited the need to evaluate and correct deficiencies regarding the controls for communicating emergencies to the UG, including the configuration and adequacy of equipment (alarms, strobes, and public address).

EA reviewed the evidence for closure of this action (ref. JON 1) submitted to CBFO. The information was limited to the configuration and adequacy of the alarms, strobe lights, and public address system. It did not address the MSHA requirements in 30 CFR §57.20032 requiring two-way communications from UG operations to the surface, and more specifically in 30 CFR §57.4363, which requires a fire alarm system capable of warning every person underground to evacuate the mine.

In addition to the actions submitted to CBFO for closure of JON 1, NWP installed an Underground Wireless Mine Notification System, intended to provide the ability to communicate with individuals in the mine by multiple methods. The notification units of this system allow two-way communications by means of text, audible alarms, visual alarms, and vibration to notify miners in the event of an emergency. This system has the potential to satisfy all the alarm and communications requirements if performance meets expectations.

Overall, EA determined that development and implementation of NWP actions to address JON 1 were acceptable.

5.3 Integration of Fire Hazards Analyses and Documented Safety Analyses

This section discusses EA's assessment of integrating the technical basis for the risks associated with fire and explosions from the FHA to the DSA.

Criteria

FHAs have been prepared for each nuclear facility, with the conclusions integrated into the DSA as appropriate. (DOE Order 420.1C, DOE-STD-1066-2012)

The safety authorization basis is consistent with the FHA; demonstrates the adequacy of controls provided to eliminate, limit, or mitigate identified hazards; and defines the processes for maintaining the controls. (DOE Order 420.1C, DOE-STD-1066-2012, 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. The FHA and self-assessments address all essential elements for a complete analysis as delineated in DOE Order 420.1C. The information contained in the FHA and assessment is accurate, as required by applicable fire safety criteria. (DOE Order 420.1C)

In accordance with DOE Order 420.1C, 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 the fire accidents analyzed in the DSA and the actual fire hazards analyzed in the facility. EA determined that the facility fire hazards and fire scenarios identified in the WHB FHA are consistent and appropriately integrated into the corresponding safety basis documents. In addition, the FHA and DSA appropriately identify and describe the fire protection systems, controls, and facility-specific areas. EA's review was limited by the fact that the DSA was in transition during the assessment.

The site does not have a formalized process for integrating the FHA and DSA through a controlled procedure. Instead, the changes and updates to the FHAs are evaluated through the unreviewed safety question process, thereby maintaining the integration of the FHA conclusions with the DSA.

Although the FHA appropriately addresses most design attributes, two FHA statements about design attributes have not been adequately analyzed or documented. First, the FHA indicates that the interim high efficiency particulate air (HEPA) filters will include bubble tight fire dampers operated by a line-type heat detector on the outside of the ventilation ductwork. Although the line type fire detection and the absence of a fire screen are deviations from DOE-STD-1066-2012, the FHA concludes that the alternatives adopted at WIPP provide an equivalent level of safety. Contrary to DOE-STD-1066-2012, this approach did not adequately analyze the risk of omitting the recommended controls or providing an equivalent level of safety.

Second, the FHA describes the UG facilities and controls as they relate to the ventilation system and means to address smoke migration. The FHA states: “The bulkheads, airlocks, and overcasts are of noncombustible construction (i.e., metal) with the exception of flexible seals required to accommodate salt movement. While not fire rated, the airlocks serve as effective barriers to smoke movement.” Although the airlocks will contribute to managing smoke migration in the event of a fire, no documented analysis or evaluation has established these controls as effective barriers to smoke movement as required by DOE Order 420.1C.

In discussions of these items with EA, NWP stated that they will be addressed in the next revision to the FHA.

5.4 Engineered System Design Features/Firewater Supply and Distribution

EA reviewed the fire protection systems for the WHB and UG. In general, the fixed fire protection features supporting the active and passive systems provide adequate protection and meet the applicable codes and standards described in the FHA.

EA identified several significant areas of concern regarding the firewater supply and distribution. Each of these areas represents a decreased margin of reliability and adequacy for this system

Criteria

A complete spectrum of fire prevention controls and procedures have been developed and implemented to eliminate, limit, or mitigate identified hazards, as required by applicable fire safety criteria. (DOE Order 420.1C; site and facility procedures)

Technical, functional, and performance requirements for the systems are specified in (or referenced in) the facility authorization basis documents consistent with the facility FHA. These authorization basis documents identify and describe the system safety functions, and these criteria are translated into design calculations and procedures. (DOE Order 420.1C; site and facility procedures)

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 DOE directives and standards, NFPA codes and standards, and FHAs have been installed and are tested and maintained to ensure that they can perform the designated safety functions under analyzed and plausible accident conditions. (DOE Order 420.1C, DOE-STD-1066-2012, NFPA 13, NFPA 22, NFPA 801)

A reliable and adequate water supply and distribution system must be provided for fire suppression, as documented through appropriate analysis. (DOE Order 420.1C)

A means for collecting and containing a credible quantity of fire suppression water for a minimum of 30 minutes is provided to avoid the spread or release of radioactive material during a fire. (DOE-STD-1066-2012, NFPA 801)

Safety Support Systems. The safety significant portion of the fire protection system includes portions of the firewater supply and distribution system, including the firewater storage tank, fire pumps, a portion of the UG ring main and distribution piping that are part of the fire sprinkler piping, supply risers, and control valves supplying the WHB. EA observed that the design and installation of support systems are generally adequate but in some cases lack the appropriate classification.

In reviewing the safety and support systems, EA found inadequate safety classification of the electric power to provide freeze protection for the safety significant FSS. Contrary to DOE Order 420.1C, which states that “Support SSCs must be designed as safety-class or safety-significant SSCs if their failures prevent safety-SSCs or specific administrative controls from performing their safety functions,” the electric heat tracing for the safety significant firewater storage tank and FSS piping was not likewise classified.

A similar example includes the backup safety significant electric firewater pump. WIPP TSR § 3/4.1 requires the operable FSS to have either fire pump 45-G-601 or 45-G-602 operable. The electric fire pump does not have a safety grade electrical supply to ensure continued operation upon loss of power, contrary to DOE-STD-1066-2012, which states, “The system of pumps and drivers should be designed such that loss of primary electrical power will not prevent the system from meeting the design demand.” The FHA does not identify either of these concerns.

Redundancy of Firewater Supply. The system boundary for the WHB FSS includes the supply risers and distribution piping with sprinklers that provide fire suppression capability to the WHB. The firewater loop distribution is adequately sized, with the required spacing of fire hydrants and location of isolation valves. However, EA observed several conditions that could compromise the performance and reliability of the safety significant firewater supply system.

The WHB underground firewater supply consists of three 6-inch lead-ins, two of which feed the safety significant sprinkler risers from the north and south side. An internal cross connection, installed in 2008, allows the system to be fed from either riser supplying the CH Bay, Room 108, and the Waste Hoist Tower sprinkler systems, all of which are classified as safety significant SSCs in accordance with the WIPP DSA and TSRs.

The 6-inch underground lead-in supplying firewater from the north side was impaired due to a pipe failure in October 2015. NWP had not determined the root cause for this significant pipe break at the time of this assessment. Although the location of the pipe failure has been excavated, there are no documented compensatory actions to address the increased risk of the impaired safety significant firewater supply. In addition, NWP has not scheduled a date for repair and restoration. This underground piping arrangement is contrary to DOE-STD-1066, which specifies a water distribution system providing two-way flow with sectional valves arranged to provide alternate water flow paths to any point in the system, to fulfill the requirement of a reliable water supply. The original design standards (i.e., code of record) for the FSS, which included DOE Order 6430.1A, required redundant fire pumps and a loop configuration for the firewater supply.

Age Degradation. Improvements to the firewater piping have been reactive and limited to the replacement of failed or leaking pipe. EA identified the potential for degraded conditions of the UG

firewater distribution system, based on numerous occurrences involving firewater leaks and pipe failures of the UG water supply. A total of 11 occurrences have been recorded as a result of corrosion of the firewater piping. The concern expressed by both CBFO and NWP, during interviews with EA, is that the corrosion is due to the salt content in the soil – i.e., the ductile lined pipe is being corroded from the outside in. EA examined samples of the recently failed pipe, which clearly revealed severe signs of corrosion and pitting from the outside of the piping.

Although NWP and CBFO have known about this piping degradation because of prior occurrences involving pipe failures, they have not formally evaluated or analyzed the condition of the UG piping. Further, the FHA does not identify this as a deficiency with respect to the reliability and adequacy of the firewater supplying a credited safety fire protection system. In addition, there are no documented plans to replace the aged piping with material that is less susceptible to corrosion. A significant potential exists for the UG piping to fail under the pressure surges that would normally occur when a sprinkler system is activated or a fire hydrant is operated during a fire.

Performance Degradation. The primary firewater diesel pump and backup electrical pump have not been evaluated for degradation. NFPA 25, *Standard for the Inspection, Testing and Maintenance of Water-Based Fire Protection Systems*, requires that the results of the annual pump test be evaluated against the certified pump curve to determine pump performance compliance. It is essential to monitor degradation of credited SSCs since degradation will directly affect their ability to meet the safety related performance requirements.

The purpose of the annual pump test is to demonstrate that the performance of the fire pump developed head has not degraded more than 5% from the pump manufacturer’s certified acceptance pump curve when measured at shutoff (churn), and at 100% and 150% flow. NWP has not analyzed the data from the annual pump test to ensure adequate pump performance by comparison to the baseline acceptance pump curve, using the degradation criteria established by NFPA 25.

Conclusions. Overall, EA observed numerous safety-related deficiencies affecting the reliability and adequacy of firewater supply and distribution. Given the number of pipe failures due to corrosion, the configuration of the water supplies, the lack of redundancy, and the absence of a documented analysis of the UG piping condition, there are significant weaknesses in ensuring that the required water demand will be met during a fire (see **Finding F-WIPP-02**).

Containment of Contaminated Water

Both NFPA 801, *Standard for Fire Protection for Facilities Handling Radioactive Materials*, and NFPA 400, *Hazardous Materials Code*, require the secondary containment for hazardous materials to have sufficient capacity to contain the volume of the largest vessel and the water from fire suppression activities. NFPA 801 requires a “credible” quantity of fire suppression water, as determined by the FHA, and states that this is not intended to be a worst case. NFPA 400 requires the sprinkler discharge to be from the minimum design area, the room area, or the storage area, whichever is smaller. For a diked or curbed vessel, the expected additional volume for the sprinkler discharge need only consider the sprinkler discharge density over the diked area. The design objective of both standards is to prevent the spread of hazardous materials via the fire suppression water. Although the WHB FHA identifies the expected volume of water as a result of the discharge of sprinklers, it does not evaluate whether the interior trenches and sumps would be adequate to control and collect the contaminated water runoff (**Deficiency**).

Diesel Mine Equipment – Fire Suppression

The AIB for the salt truck fire identified that a key element for ensuring mine habitability was for NWP to conduct operational checks of safety-related equipment in the mine, including FSS on diesel-powered equipment. To address this issue, NWP included a corrective action to be completed 180 days after resumption of UG access. JONs 8 and 9 (the need to review fire procedures and define expectations for responding to fires in the underground) impact these corrective actions related to the installation of automatic FSS on mobile liquid fueled waste handling and mining equipment. EA reviewed the status of the implementation of this corrective action.

Criteria

A documented fire risk assessment shall be performed for all diesel-powered underground mining equipment, all self-propelled and mobile surface mining equipment, storage and handling of flammable and combustible liquids, and surface metal mineral processing facilities. (NFPA 122, Section 5.1.1)

The fire risk assessment shall determine whether mobile or other equipment, fuel depots, and surface buildings and metal mineral processing facilities require a fixed fire suppression system. (NFPA 122, Section 5.1.4)

The fire risk assessment shall include evaluation of the risk potential for the start and spread of a fire and the generation of smoke, gases, or toxic fumes that could endanger the lives and safety of personnel or cause damage to property. (NFPA 122, Section 5.1.7)

Diesel-powered equipment shall be protected by a fixed fire suppression system to suppress the largest anticipated fires in the protected areas. (NFPA 122, Section 7.4)

The NWP corrective action plan was to redesign the UG mobile diesel-powered equipment automatic FSS to make them more reliable. NWP has prioritized these actions to address the equipment necessary to begin waste emplacement and has identified 13 specific diesel-powered units. All other diesel equipment is to be addressed on a priority basis, as operations resume. EA identified this condition as an item for follow-up.

NWP has determined that all UG equipment with more than a 40-gallon capacity of flammable liquids will be equipped with fire suppression based on ETO-Z-157, *Fire Protection Engineering Determination of UG Diesel-Powered Equipment that Requires Automatic Fire Suppression System Installation and UG Equipment Evaluated as NOT Requiring Automatic Fire Suppression System Installation* (February 4, 2015). The criteria are based on the concern about plugging of the HEPA filters, but the evaluation did not include the NFPA 122, Section 5.1.7 requirement for a fire risk assessment of the risk potential for the start and spread of a fire and the generation of smoke, gases, or toxic fumes that could endanger the lives and safety of personnel.

Although MSHA, the mining industry, and subsequent analysis of the fire at WIPP have shown that external brakes (brakes other than wet disc brakes) pose a significant fire hazard on UG diesel-powered mining equipment, none of the fire risk assessments that EA reviewed addressed the braking systems of the UG equipment. While some of this equipment uses enclosed wet brakes, other equipment has external parking brakes similar to those involved in the salt truck fire that should be addressed in the fire risk assessments (see **WIPP – OFI-01**).

5.5 Surveillance and Testing

EA's assessment of the WIPP fire protection surveillance and testing program was limited due to the limited operations and tests that were performed during the assessment, and review of TSR surveillances was excluded due to an ongoing EA assessment that addressed this topic.

Criteria

Surveillance and testing is performed to demonstrate that the fire protection system, including supporting infrastructure, is capable of accomplishing its safety functions and continues to meet applicable system requirements and performance criteria. (DOE Order 420.1C, DOE-STD-1066-2012)

Surveillance and test procedures are established for implementing the ITM program. Test results are reviewed by qualified FPEs and other qualified persons and compared to previous data to identify adverse trends in system performance or reliability. A preventive maintenance program is established to perform regular preventive or corrective maintenance repairs to ensure operability of the system or equipment. (DOE Order 420.1C; DOE-STD-1066-2012; NFPA codes and standards)

Records are maintained consistent with the requirements of DOE Administrative Records Schedule 18, Security, Emergency Planning and Safety Records. (DOE Order 420.1C; DOE Administrative Records Schedule 18; NFPA codes and standards)

Fire protection system testing confirms the key operating parameters for the system and components and the system's ability to accomplish their safety functions. In most cases, the applicable ITM provisions of NFPA indicate that FSS systems and components credited to perform a safety function are to be tested and inspected on an acceptable periodic basis.

EA found that the ITM procedures for the FSS and associated components identify the applicable requirements. However, not all of the safety significant FSS boundary valves have been tested and maintained, including valves V-014 and DW- 456-V-005.

EA witnessed several ITM evolutions to assess the fire system's capability and the technicians' level of knowledge. Procedure WP 12-FP0025, *Sprinkler System Inspection and Testing*, was used for testing the WHB safety significant fire suppression. EA observed that the technicians omitted critical steps, such as identifying the firewater control valves installed in 2008. Further, the technicians responsible for performing ITM for the fire systems exhibited limited system knowledge and could not explain the purpose of the test.

The WIPP lightning protection system uses the plant ground system and consists of lightning arrestors located at select substations and a lightning dissipation system. The WIPP FHA states: "The lightning protection systems are inspected and maintained in accordance with manufacturers' requirements and at a frequency specified in NFPA 780." However, NWP could not provide any documentation showing that inspection and routine maintenance had been performed for this system. EA identified maintenance and inspection of the lightning protection system as an item for follow-up.

Overall, EA observed that the ITM procedures used for the fire protection systems were adequate. NWP's plan to acquire NICET (National Institute for Certification in Engineering Technology) certified technicians for future testing of fire protection systems should address the issue of the knowledge level of personnel performing this work.

5.6 Configuration Management

Criteria

A configuration management process is established and adequately integrates the elements of fire protection system requirements and performance criteria, system assessments, change control, work control, and documentation control. Changes to the fire protection system requirements, documents, and installed components are formally designed, reviewed, approved, implemented, tested, and documented. (DOE Order 420.1C, DOE-STD-1066-2012)

An unreviewed safety question (USQ) process has been established in accordance with 10 CFR 830 and is appropriately implemented for making controlled changes on fire safety systems, including those documents that govern work to be performed. (10 CFR 830; DOE Order 420.1C; DOE-STD-1066-2012)

By reviewing fire protection technical drawings and procedures, EA found that for the most part, the NWP configuration management program is being maintained and reflects the field conditions for the fire protection SSCs. Some isolated instances of discrepant information, including inconsistencies among safety basis and supporting technical documents, indicate minor weaknesses in configuration control.

For example, during a facility walkdown of the firewater storage tank and accessories, EA observed FSS boundary valves that were not identified or controlled. The drain valve for the firewater storage tank was labeled as a domestic water valve, indicating that the FSS safety significant valve alignment was not accurate.

Before EA observed a scheduled evolution involving the diesel fire pump weekly functional test, the technician noted that the fire pump controller was in the OFF position, instead of AUTO. The technician responded with the appropriate actions, resulting in the facility shift manager arriving at the pump house and restoring the controller to the AUTO position. EA followed up with WIPP operations personnel and discovered that an operator had been asked to take the diesel fire pump off line to support electrical preventive maintenance on the fire alarm panel in the pump house. The facility shift manager stated that this work was controlled in accordance with procedure and that configuration control had not been compromised; however NWP could not produce any documentation supporting that claim, despite numerous requests by EA. The actions of WIPP operations personnel did not follow the requirements of the fire impairment procedure, WP 12-FP3001, *Fire Protection Impairment*. For example, they had not considered the required compensatory measures, such as a fire watch, even though the system had been out of service for more than four hours.

5.7 DOE Field Element Oversight

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)

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, 4b (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 226.1.B, 4b (5))

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

CBFO performs line management oversight of the FPP and fire protection safety systems in accordance with DOE/CBFO 09-3439, *Office of Operations Oversight Safety System Oversight Program Plan*, and DOE/CBFO-04-3299, *CBFO Contractor Oversight Plan*. CBFO has established a safety system oversight (SSO) program as defined in DOE Order 426.1, *Federal Technical Capability*, for qualifying staff to apply expertise in their oversight of assigned safety systems and safety management programs. DOE/CBFO 09-3439, Section 3, identifies the roles and responsibilities for SSO personnel and associated management and establishes the program requirements related to oversight of safety systems and programs. CBFO Plans also assign responsibilities for SSO personnel to monitor designated facilities and systems, and provide input to line management.

CBFO has a trained and qualified FPE in accordance with DOE Order 426.1A, *Technical Qualification Program Plan*, and the *Safety System Oversight Representative (SSOR) Qualification Standard*. After reviewing the qualification card and training records for the SSO representative for fire protection systems, EA concluded that the CBFO FPE meets the established requirements.

The CBFO FPE attends contractor meetings, assists in conducting FPP self-assessments, updates the fire protection material conditions report, maintains a list of impaired and out-of-service systems, reviews contractor FPP documents (such as the BNA, FHA, and FPP description document), and provides input to monthly and quarterly reports. The CBFO FPE performs walkthroughs of the WHB and UG facility approximately twice a month to evaluate implementation of the NWP combustible controls, housekeeping, and hot work programs. However, no documentation of these surveillances was available as required by CBFO MP 10.9, *Surveillance, Operational Awareness, and Issues Management*, Section 5.3 (**Deficiency**).

DOE/CBFO 09-3439, Section 3.4 requires oversight personnel to perform periodic evaluations of equipment configurations, oversight of systems, reviews of test reports, evaluation of aging of system equipment and components, assessment of work control and change control processes, evaluation of system maintenance and surveillance of safety significant functions, and assessments of the timely evaluation and correction/restoration to service of systems in their area of responsibility. The CBFO FPE could not provide evidence that reviews of fire system test reports and the evaluation of system maintenance and surveillance of safety significant functions are performed (**Deficiency**).

The CBFO Director of Facility Engineering Division is responsible for the scheduling and performance of triennial self-assessments of the contractor FPPs and WIPP fire and rescue operations. CBFO performs periodic functional area reviews of the NWP FPP in accordance with its annual assessment implementation plan. CBFO completed a contractor FPP assessment, S-15-03 (October 14-16, 2014) to satisfy the triennial self-assessment requirement from DOE Order 420.1C. Overall, this CBFO FPP assessment was comprehensive and identified three conditions adverse to quality, six observations, and three recommendations. However, CBFO did not follow up to verify tracking of issues and corrective actions for closure.

CBFO completed a scheduled assessment of the CBFO FPP on June 1 – August 31, 2014. An independent third-party FPE and the CBFO fire protection subject matter expert in the position of

oversight conducted the self-assessment. However, the CBFO FPE has not yet formally issued this self-assessment report.

EA concluded that the CBFO fire protection subject matter expert is knowledgeable of the site fire protection systems but is not adequately engaged in providing oversight of the contractor ITM programs. CBFO conducts comprehensive periodic reviews of the NWP FPP, but does not adequately track identified issues and corrective actions to closure.

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 appraisal 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-WIPP-01: NWP has not provided adequate emergency escapeways from the mine as required by 30 CFR §57.11050 and §57.11051.

Finding F-WIPP-02: NWP has not provided reliable and adequate water supply and distribution for fire suppression, contrary to DOE Order 420.1C, Attachment 2, Chapter II, Section 3.b.(3)(e).

7.0 OPPORTUNITIES FOR IMPROVEMENT

EA identified one OFI to assist cognizant managers in improving programs and operations. While OFIs may identify potential solutions to findings and deficiencies identified in appraisal reports, they may also address other conditions observed during the appraisal process. EA offers this OFI only as a recommendation for line management consideration; it does not require formal resolution by management through a corrective action process and is not intended to be prescriptive or mandatory. Rather, it is a suggestion that may assist site management in implementing a best practice or provide a potential solution to an issue identified during the assessment.

OFI-WIPP-01: NWP should consider determining the risk associated with braking systems in light of previous experience with external brakes on the salt truck fire at WIPP and the experience of similar equipment in metal mines.

8.0 ITEMS FOR FOLLOW-UP

EA will follow up the items listed below, many of them related to incomplete program implementation or key documents awaiting approval:

- The FPP, BNA, FHA, and equivalency and exemption processes
- The implementation of the combustible loading program
- The closure packages supporting the AIB report

- The application of FSS on diesel-powered equipment
- The ITM documentation for the lightning protection system.

Appendix A Supplemental Information

Dates of Assessment

Onsite Assessment: February 29 – March 3, 2016

Office of Enterprise Assessments (EA) 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, Deputy Director, Office of Environment, Safety and Health Assessments
Patricia Williams, Director, Office of Worker Safety and Health Assessments
Gerald M. McAteer, Director, Office of Emergency Management Assessments

Quality Review Board

William A. Eckroade
John S. Boulden III
Thomas R. Staker
William E. Miller
Patricia Williams
Gerald M. McAteer
Michael A. Kilpatrick

EA Site Lead for WIPP

Jeff Snook

EA Assessors

Jeff Robinson P.E., CSP – Lead
Pete Turcic
Barry Snook

Appendix B

Key Documents Reviewed, Interviews, and Observations

Documents Reviewed

- WIPP-023, Rev. 7, *Fire Hazard Analysis for the Waste Isolation Pilot Plant*, August 31, 2015
- CF00-GC00, Rev. 31, *Plant Buildings, Facilities, and Miscellaneous Equipment System Design Document*, 11/03/15
- U.S Department of Energy Office of Environmental Management Accident Investigation Report, *Underground Salt Haul Truck Fire at the Waste Isolation Pilot Plant*, February 5, 2014, March 2014
- DOE/WIPP 07-3372, Rev. 5, *Waste Isolation Pilot Plant Documented Safety Analysis*, DRAFT
- EA12FP3004-1-0, Rev. 0, *Underground Pre-Incident Plan*, 9/24/15
- EA12FP3004-1-0, Rev. 0, *411 Waste Handling Building Pre-Incident Plan*, 9/22/15
- WP 04-AU1030, Rev. 1, *Diesel Forklift Preoperational Requirements*, 3/6/15
- WP 04-AU1031, Rev. 0, *Roof Bolter Preoperational Requirements*, 11/12/14
- WP 04-AU1032, Rev. 0, *Scissor Lift Preoperational Requirements*, 12/4/14
- WP 04-AU1033, Rev. 0, *Load Haul Dump Preoperational Requirements*, 1/13/15
- WP 04-AU1038, Rev. 0, *Haul Truck Preoperational Requirements*, 4/17/15
- WP 04-AD3013, Rev. 36, *Underground Access Control*, 8/17/15
- WP 10-AD3032, Rev. 1, *Lube Truck Preoperational Requirements*, 1/30/15
- WP 12-FP.01, Rev. 13, *WIPP Fire Protection Program*, 11/28/12
- WP 12-FP.01, Rev. 14, *WIPP Fire Protection Program*, DRAFT
- WP 12-FP.03, Rev. 0, *WIPP Fire Department Program Plan*, 8/28/15
- WP 12-FP.04, Rev. 0, *WIPP Fire Department Training Plan*, 8/28/15
- WP 12-FP.05, Rev. 0, *WIPP Wildland Fire Management Plan*, 8/28/15
- WP 12-FP.07, Rev. 0, *WIPP Combustible Control Program*, 10/28/15
- WP 12-FP.23, Rev. 0, *WIPP Baseline Needs Assessment*, DRAFT
- WP 12-ER.04, Rev. 1, *WIPP Fire Suppression Response and Operations Guide*, 9/24/15
- WP 12-ER.25, Rev. 0, *Underground Escape and Evacuation Plan*, 1/7/16
- WP 12-FP0025, Rev. 6, *Sprinkler System Inspection and Testing*, 10/21/15
- WP 12-FP0027, Rev. 2, *U/G Fuel Station Dry Chemical Fire Suppression System*, 12/31/14
- WP 12-FP0033, Rev. 3, *Inspection of Emergency Response Equipment*, 12/1/14
- WP 12-FP0051, Rev. 2, *Emergency Lighting System Inspections and Testing*, 12/3/14
- WP 12-FP3001, Rev. 8, *Fire Protection Impairment*, 10/29/14
- WP 12-FP3002, Rev. 15, *Hot Work Permits*, 10/21/15
- WP 12-FP3003, Rev. 17, *Combustible Materials and Compressed Gas Cylinder Checks*, 10/7/15
- WP 12-FP3003, Rev. 18, *Combustible Materials and Compressed Gas Cylinder Checks*, 2/15/16
- WP 12-FP3004, Rev. 4, *WIPP Fire Department Pre-Incident Plans*, 9/22/15
- WP 12-FP3006, Rev. 0, *WIPP Combustible Control Permitting*, 10/28/15
- EA12FP3003-2-0, Rev. 3, *Underground Combustible Materials and Cylinder Check Sheet*, 2/22-28/16
- EA12FP3004-1-0, Rev. 0, *Underground Pre-Incident Plan*, 9/24/15
- EA12FP3004-1-0, Rev. 0, *Building 411 WHB Pre-Incident Plan*, 9/22/15
- EA15PC3041-2-0, Rev. 5, *Hazard Analysis for Demolition of Old Fire System, Install New Amerex VS System*, May 30, 2015
- MA-EM-2015-21, Rev. 2, *NWP Evaluation of the Visibility and the Audibility of U/G Communication Systems*, July 11, 2015

- DOE/CBFO 09-3439, Rev. 1, *Office of Operations Oversight Safety System Oversight Program Plan*, December 2015
- CBFO MP 4.2, Rev. 11, *Document Review*, January 13, 2015
- CBFO MP 10.9, Rev. 2, *Surveillance, Operational Awareness, and Issues Management*, 10/7/2015
- Jenson Hughes, *Fire Protection Assessment of the Fire Protection Program Waste Isolation Pilot Plant*, June 2015
- MA-XX-XX, *CBFO Self-Assessment of the Fire Protection Program*, June 1 - August 31, 2014
- S-15-03, *NWP Compliance with DOE Order 420.1C, Facility Safety, Appendix 2, Chapter II, Fire Protection*, October 14-16, 2014
- DOE/CBFO 09-3439, Rev. 2, *Office of Operations Oversight Safety System Oversight Program*, December 2015
- CBFO FPE WIPP Site Fire Protection Material Condition, April 30, 2015
- CBFO FPE WIPP Site Fire Protection Material Condition, June 21, 2015
- CBFO FPE WIPP Site Fire Protection Material Condition, July 23, 2015
- CBFO FPE Weekly Status Report, January 10, 2014
- CBFO FPE Weekly Status Report, January 17, 2014
- CBFO FPE Weekly Status Report, January 24, 2014
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- Matrix Status Spreadsheet for CBFO JON corrective actions
- AIB Judgement of Needs Closure Status, 2/25/16
- JON 10.1, Identify fire-related personal safety equipment for the underground.
- JON 10.2, Evaluate and revise training associated with the underground fire-related equipment to include hands-on training and recurring proficiency requirements.
- JON 13.1, Revise engineering procedures to provide formal process to identify applicable maintenance requirements.
- JON 13.3, Review and revise, as necessary, PM procedures for underground equipment.
- JON 20.1, The CBFO Fire Protection SSO will oversee NWP evaluation of fire suppression system to be used in the underground that are appropriate to the analyzed hazard.
- JON 20.2, The CBFO Fire Protection SSO and Ventilation SSO will ensure NWP has fully analyzed credible fire scenarios through the review of the NWP FHA, BNA, and EPHA.
- JON 21.1, The CBFO Fire Protection SSO and Facility Representatives will perform periodic (not to exceed monthly) operational awareness walk-throughs and inspections to ensure combustible material loading is controlled in the WIPP underground.
- JON 21.2, The CBFO Fire Protection SSO will evaluate the NWP Contractor Assurance System for combustible controls.
- JON 22.1, The CBFO Fire Protection SSO and Facility Representatives will perform periodic (not to exceed monthly) operational awareness oversight to identify housekeeping conditions that impede egress from the underground.
- JON 22.1, The CBFO Fire Protection SSO will evaluate the NWP Contractor Assurance System for housekeeping.
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- Ron Perrin Water Tank Inspection Report, 2/5/2015
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- WP 04-AD3013, Rev. 36, *Underground Access Control*, August 17, 2015
- WP 04-AU1026, Revision 6, *Self-Rescuer Inspection Technical Procedure*, April, 20, 2015
- WP 12-ER4911, Rev. 18, *Underground Fire Response*, November 25, 2015
- WP 12-ER.13, Rev. 0, *WIPP Drills and Exercises*, November 20, 2014
- WP 12ER.25, Rev. 0, *Underground Escape and Evacuation Plan*, January 7, 2016
- WP 12-ER4911, Rev. 18, *Underground Fire Response*, November 25, 2015
- WP 15-GM.02, Rev. 10, *Worker Safety & Health Program Description*, October 1, 2015
- WIPP Underground Escape and Evacuation Map, January 11, 2016
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- *MSHA Program Policy Manual Volume IV - Metal and Nonmetal Mines*
- WIPP AAR EX-2014-02, *Horizon-14*, December 10, 2014
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- WIPP AAR DR-2015-16, *CMR Underground Fire Response*, February 16, 2015
- WIPP AAR DR-2015-67, *Underground Fire Evac-Medical Response*, June 18, 2015
- WIPP AAR DR-2015-101, *Underground Fire/EVAC*, November 24, 2015
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- WIPP AAR DR-2016-02, *Underground Services*, January 27, 2016
- WIPP Drill Plan DR-2015-13, *No Notice Underground Evacuation*, February 11, 2015
- WP 12-FP0025, *Sprinkler System Inspection and Testing*, Rev. 5, 11/12/13

Interviews

- Engineer
- Operators (2)
- Shift Operations Managers (2)
- Shift Supervisors (2)
- Shift Technical Engineer
- Fire Protection Manager
- Fire Chief
- Daytime Fire Captain
- Firefighters
- Emergency Preparedness Manager
- Corrective Actions Manager
- Records Management Manager

Observations

- Team Daily Meetings
- Daily Meetings
- Evolution

- Walkdown
- Underground Tour and Walkdown
- Waste Handling Building Tour and Walkdown
- Main Drain Test WHB Wet Pipe Sprinkler System
- Central Alarm Control Room Tour
- Vehicle Fire Suppression System Installations
- UG Emergency Response Vehicles
- Underground Inspections (4)

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 pre-incident plans for the UG and WHB do not include the information required by WP 12-FP3004, Section 1.1 and NFPA 1620, *Standard for Pre-Incident Planning*, Section 5.3.1.
- NWP has no documented process for developing exemptions and equivalencies in accordance with DOE Order 420.1C, Attachment 2, Chapter II, Section 3.d (2) (c).
- NWP has no records of facility/building fire safety assessments for the WHB or UG in accordance with DOE Order 420.1C, Attachment 2, Chapter II, Section 3.f (2).
- NWP has no procedure for conducting FHAs as required by DOE Order 420.1C, Attachment 2, Chapter II, Section 3.d (1) (h).
- WP 12-FP3002 does not require verification that a portable fire extinguisher is available at the hot work area and that flammable and combustible materials are removed out to a radius of 35 feet from the hot work in accordance with the FPP, FHA, and NFPA 51B.
- WP 12-FP3001 does not have a fire impairment program conforming to DOE Order 420.1C, Attachment 2, Chapter II, Section 3.d (1) (f).
- Contrary to NFPA 801, the FHA does not evaluate the requirements necessary for containment resulting from fire suppression activities.
- CBFO does not document its surveillances in accordance with CBFO MP 10.9, Section 5.3.
- CBFO does not document reviews of fire system test reports and the evaluation of system maintenance and surveillance of safety significant functions as required by DOE/CBFO 09-3439, Section 3.4.