

**EM-3.112 Office of Operational Safety Assurance
Waste Isolation Pilot Plant
Review**

July 10 – 15, 2017



**U.S. DEPARTMENT OF
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SUMMARY

Two members of the Office of Operational Safety (EM-3.112) visited the Waste Isolation Pilot Plant (WIPP) July 10 – 15, 2017 to evaluate Nuclear Waste Partnership's (NWP) response to recent electrical safety issues, lock-out/tag-out (LOTO) program, Supplemental Ventilation System testing issues, and Safety Management Program (SMP) Key Element (KE) implementation and maintenance. Along with evaluating the sufficiency of the aforementioned, EM-3.112 tasked the members with providing recommendations in order to improve NWP's performance in the evaluated areas, thus a series of recommendations are included in the report for consideration by the DOE's Carlsbad Field Office (CBFO) and NWP. EM-3.112 will provide recommended performance indicators/metrics by the end of September 2017 for those KEs which don't have them.

BACKGROUND

Due to several recent electrical safety, Lockout/Tagout (LO/TO), and ventilation system testing issues, EM-3.112 evaluated the actions taken by Nuclear Waste Partnership to address the issues.

The WIPP Documented Safety Analysis (DSA) and Technical Safety Requirements (TSR) identify Key Elements (KE) for nine of the DSA's SMP chapters. KE infrastructure was evaluated during the DSA/TSR revision 5 Implementation Verification Review; however, there was insufficient data regarding KE compliance to effectively assess KE implementation and maintenance. EM-3.112 also evaluated the processes NWP utilizes to evaluate the sufficiency of the KEs.

RESULTS

Electrical Safety

Nuclear Waste Partnership (NWP) initiated an electrical work safety stand down at the Waste Isolation Pilot Plant (WIPP) on Thursday, June 15th. The reason for this stand down was based on several maintenance related electrical work where the electrical hazards were not properly considered in the development and execution of the work which resulted in improper electrical Personal Protective Equipment (PPE) being worn during work execution. A Timely Order 17:028, *FSM Authorization to Release Electrical Work*, was initiated to document and provide direction associated with limited scope electrical work. The Timely Order provided criteria for the FSM to authorize emergency racking-in and racking-out of 480v or higher breakers and a detailed list of work activities that he was authorized to release. On July 13th, the Timely Order was cancelled and the *Waste Isolation Pilot Plant Plan for Limited Resumption of Unrestricted Electrical Work* (Plan) was put into effect which provides a controlled and deliberate approach to resumption of unrestricted electrical work at WIPP. The Plan provides a graded approach for the resumption of unrestricted electrical work. In association with the Plan, six Senior Supervisory Watch (SSW) personnel were chosen to

perform Operations Management Oversight of selected electrical work. The following electrical activities require an assessment for potential oversight by an SSW (it is unclear in the Plan who conducts this assessment):

- Any energized work requiring an Energized Electrical Work Permit
- Work in panels containing live unguarded electrical connections greater than 480V (this does not apply to racking in breakers).
- Any work greater than 480V, including ground clusters installation/removal and zero energy checks
- Intrusive electrical work on substation breakers/cubicles

The duration of the Operations Management Oversight period is dependent on the satisfactory performance of electrical work. The oversight period is scheduled to continue until the NWP President/Project Manager and the Executive Safety and Quality Review Board (ESQRB) are satisfied with NWP's ability to safely and compliantly conduct electrical work. The SSWs will provide input and when the Operations Manager and Maintenance Manager believe that electrical work is being performed satisfactorily, they will make a presentation to the ESQRB. The ESQRB will either recommend continued oversight or to move forward without Operations Management Oversight. If the NWP President/Project Manager concurs with the recommendation to move forward without the SSW oversight, the Plan will be concluded.

As a result of the electrical work stand down, the following actions were taken:

- Initiation of Timely Order 17:028, *FSM Authorization to Release Electrical Work*,
- An NFPA 70E industry consultant was retained to develop electrical training and to validate NWP electrical safety procedures, manuals, and documents,
- All electrical crafts were required to attend training and passed a test on NFPA 70E, WIPP Electrical Safety Manual, and the Craft Electrical Safety Manual,
- All electrical and sub-contract supervisors were required to attend training, passed a test, and pass an oral board on NFPA 70E, WIPP Electrical Safety Manual, and the Craft Electrical Safety Manual,
- Development and initiation of an Electrical Task Risk Assessment Form,
- Enhanced Senior Supervisory Watch (SSW) for certain electrical work,
- Maintenance Management directive that Field Work Supervisors (FSW) document verification in the Work Status Log (WSL) that the proper electrical PPE was donned for the work,
- Development and initiation of the Waste Isolation Pilot Plant Plan for Limited Resumption of Unrestricted Electrical Work

A review was performed on three recent electrical events briefly described below:

- While trouble shooting a breaker at Substation 3, an electrician noticed a spark between an energized panel and keys that were hanging on a lanyard around his neck.

- An electrician was not wearing a balaclava under his head gear and face shield which was required for arc flash protection per the Electrical Safety Program Manual.
- Two related electrical events occurred while electricians were working on a 13.8 kv transformer.
 - Errors were made in implementation of electrical safety procedure steps for discharging residual energy that may have provided a shock potential.
 - An electrician felt an electric shock when he removed his electrical PPE for leather gloves after absence of energy verification but prior to ground installation.

The work package, job hazard analysis (JHA), Senior Management Review Board (SMRB) meeting minutes, fact finding minutes, occurrence report, causal analyses, extent and impact statements, and corrective actions were reviewed for thoroughness and accuracy. Not all the electrical event packages contained all of the documentation listed above. The review of the material revealed that NWP performed an adequate investigation of the events and developed reasonable corrective actions for each event. Based on these electrical events and some other electrical instances that did not meet reporting thresholds, it was appropriate that NWP initiated an electrical work safety stand down.

During the trip visit, interviews/discussions with Maintenance Management, SSW, the electrical safety industry consultant, electrical supervisors, and Facility Operations management were conducted to ascertain the degree of concern and the proposed path forward. A review of the training materials that the electrical workers and supervisors received was performed and determined to be more than adequate. No oral boards for the electrical supervisors were conducted during the trip visit. NFPA 70E training provided by the industry consultant to both CBFO and NWP was observed and determined to be excellent. Both shock hazards and arc flash hazards were discussed at the appropriate level and it appeared that some misconceptions by both NWP and CBFO were satisfactorily addressed. One topic regarding the use and categorization of insulating blankets did not appear to be resolved. The industry consultant's position regarding the insulating blankets was not embraced by CBFO.

As a result of the electrical events, an Electrical Task Risk Assessment Form was developed and implemented as a pilot program. The form provides information regarding:

- Task Identification
- General Information
- Shock Information
- Arc Flash Information-Incident Energy Analysis Method
- Arc-Rated Clothing and Other PPE Information

This is a vast improvement over the past practice of using a reference to an electrical PPE chart to determine the PPE requirements based on the voltage and incident energy involved. The referencing of the electrical PPE chart in the WP was a target of an EM-3.112 concern in the past but that concern was not resolved. Although this is a good step in emphasizing the information required to determine and document electrical PPE requirements, this should have been occurring in the JHA development process (i.e., identify the task-identify the electrical hazard-develop the control measure-integrate the control measures into the WP). In the long term, this form should be integrated into the JHA development process where it belongs.

A review of the selected individuals on the Operations Management Oversight (SSW) list revealed experienced and capable personnel who understand the duties and responsibilities of an SSW. However, there are no documented criteria for expertise in the electrical safety arena. Typically, an SSW provides oversight to ensure adherence to conduct of operations principles and management policies. However, in this particular situation, knowledge of electrical safety (e.g., NFPA 70E, WIPP Electrical Safety Manual, the Craft Electrical Safety Manual, etc.) is paramount and should be a prerequisite to being assigned as an SSW for high risk electrical work. Not all of the assigned SSWs have attended electrical safety training developed during the electrical stand down, although several have attended the NFPA 70E training.

Although no high risk electrical work was performed during the trip visit, two electrical activities were observed. The first was a practice session in the I&C Lab to calibrate an SVS Fan differential pressure transmitter. This practice session was to prepare the work crew for a demonstration in an upcoming MSA. The only concern identified was Step 5.1.10 which stated “Isolate transmitter input with local valves.” Having noticed that the task involved several valve manipulations, including an equalizing valve, the crew was asked why the valve manipulations were not included as job steps. The crew answered that the isolation was considered skill-of-the-craft (SOTC) and that they perform this evolution routinely. **Note:** During the MSA demonstration, the work crew did not correctly isolate the transmitter input, having incorrectly positioned the equalizing valve. Without documentation delineating what tasks are considered SOTC, NWP cannot justify that the isolation of the transmitter input is indeed SOTC and thus, the technical procedure would be deemed inadequate.

Recommendation: NWP should evaluate developing a Matrix delineating the tasks considered SOTC for all the different crafts. This is not a new concept and NWP can benchmark the SOTC Matrices developed by other EM Sites.

The second observed electrical work was the troubleshoot and repair of a fire panel. The observed steps were performed without incident but the entire work was not observed due to a conflict with a fact finding meeting. A followup of the work the next day revealed that the fault was a possible ground but the location had not been identified. The Electrical Task Risk Assessment Form was used satisfactorily for this electrical work.

A fact finding meeting regarding a possible incorrect incident energy determination was observed. On 6/5/2017, work was initiated using Work Control Document #1737954-45-B-044, *Remove/Replace VFD (Variable Frequency Drive)*. The reviews/approvals (COM/Electrical Safety/FWS) of the WCD were performed prior to the incident energy determination being recorded on the package because the FSM normally records the incident energy after the LO/TO points are established. After FACOPS release of the package, the incident energy determination was affixed to the work package (incident energy stated at <1.2 calories/cm²) but it is presently unknown who provided that value. On 6/6/2017, a complex LO/TO was hung and an absence-of-energy-verification (AOEV) was performed to the incident energy listed on the work package. Work was performed and the VFD was removed. Work was then suspended until a replacement VFD could be obtained. On 7/11/2017, the ME was reviewing the package for resumption of work when he noticed that a sticker on panel 45-B-044 said 460V. The ME declared a pause to verify proper PPE requirements to perform the AOEV. The work crew went to verify the voltage on the drawing 25-J-020-W1 but the drawing did not show the disconnect. They then went to the panel where they hung the LO/TO and the panel feeding the disconnect showed 7.7 calorie/cm². The FWS and ME determined 7.7 calorie/cm² incident energy was correct based on the drawing. The FWS requested Engineering verification of the correct incident energy. Engineering concurred with the ME and FWS that 7.7 calorie/cm² incident energy was correct. The FWS corrected the incident energy value on the WCD (redline/strike-through) and notified the Maintenance Supervisor who then notified the Maintenance Manager and Deputy Operations Manager. On 7/12/2017, because the work stoppage was categorized as a “pause”, the work crew resumed work and the VFD was replaced and the work completed.

Although conducted informally, the fact finding was conducted thoroughly and all the pertinent information was gathered to develop a timeline, causes, an issues list, and actions. This event is documented in this report to illustrate the point that the electrical safety training required after the electrical stand down appears to be having an immediate impact. The work was initiated prior to the electrical stand down and resumed after the maintenance crew attended the mandatory electrical safety training. The awareness of the ME and FWS in recognizing the incident energy discrepancy between the WCD and the electrical panel can be attributed, although not definitively, to the refresher electrical safety training the work crew attended after the initiation of the electrical stand down on 6/15/2017. The ME stated that the electrical safety training he attended was a large contributor to the heightened awareness when the crew resumed work on 7/11/2017 and discovered the discrepancy.

Electrical Safety Recommendations:

- All Operations Management Oversight personnel (SSWs) designated by the Plan should receive some combination of electrical safety training (e.g., NFPA 70E, WIPP Electrical Safety Manual, Craft Electrical Safety Manual, and Electrical Supervisor training).

- Select CBFO personnel should receive NFPA 70E training (e.g., Facility Representatives, Engineering, and Safety).
- NWP and CBFO need to reach consensus regarding situational differences on electrical safety requirements (e.g., insulating blankets, arc flash hazards, etc) to minimize work stoppage in the field.
- Electrical Task Risk Assessment Form requires additional elements (i.e., consideration of equipment condition in determining electrical PPE requirements).
- After the Electrical Task Risk Assessment Form has been used and proven effective in determining electrical PPE requirements, the form should be integrated into the JHA process, not a stand-alone attachment, since the information contained in the form should be used to determine the control measures for electrical hazards during the JHA development phase.
- NWP delineate in the WIPP Plan for Limited Resumption of Unrestricted Electrical Work what position(s) performs the assessment to determine if SSW oversight is required.
- Enhanced oversight by CBFO for electrical work under the newly implemented WIPP Plan for Limited Resumption of Unrestricted Electrical Work.
- EM-3.112 follow-up on effectiveness of the WIPP Plan for Limited Resumption of Unrestricted Electrical Work before NWP declares unrestricted electrical work.

LO/TO

In the past at WIPP, the Lockout/Tagout (LO/TO) process has not been integrated into the work planning and control process. The work package (WP) would contain a step to perform a LO/TO in accordance with the LO/TO procedure. Most of the time, the step would not even identify the system/equipment/component that was to be LO/TOed. The Facility Shift Manager (FSM) or Cognizant Operations Manager (COM) would prepare the LO/TO during the work release process or when the maintenance supervisor requested the LO/TO at that step in the WP. The weakness in this process had been previously identified by EM-3.112 but no action was taken to modify this approach by the previous contractor. Now, a new LO/TO process is being proposed by NWP Management where a dedicated team, lead by a qualified FSM, would prepare all LO/TOs during the planning phase of the WP. This method is a far superior process that integrates the LO/TO into work planning and decreases the possibility of single point failures. This proposed process is scheduled for implementation in late July.

Recommendation: Enhanced independent NWP and CBFO oversight of the new LO/TO process when it is implemented.

Unexpected Fan Trips during SVS Fan Testing

A review was conducted of an incident where an IVS fan tripped during SVS fan testing. On May 5, 2017, during functional testing of the SVS Fan (WO 1733771), there was an unexpected shutdown of IVS Fan 41-B-960A. The IVS Fan shutdown occurred when a step in the WCD required the CMR Operator to attempt to remotely shut down the SVS Fan. The CMR Operator attempted to perform this step but the IVS Fan shut down followed by the SVS Fan. A pause was taken in functional testing of the SVS Fan. The CMS Engineer determined the cause of the inadvertent shutdown of an IVS Fan was a CMS software error caused by cutting-and-pasting a modification without changing the IVS fan to the SVS fan. On May 6, 2017, functional testing of the SVS Fan resumed followed by a second shutdown of the IVS Fan. The second shutdown was caused by a similar software issue that was discovered the day before. Although the CMS Engineer had corrected the CMS software, he did not "publish" the change so the change was not correctly implemented. On May 6, 2017, WIPP Form 17-418 was being used to develop corrective actions for both days since it is the same issue. A review of WIPP Form WF17-418 and WF17-649 (result of Management Observation 6-12-17) and an interview with the Lead Startup Engineer revealed an adequate identification of issues and corrective actions, with one exception. The Management Observation identified that the process for making software changes that affect system operability is not well defined and that the process for documenting and dispositioning test deficiencies is also not well defined. However, the corrective actions to address these deficiencies do not address why the procedure did not contain these basic processes. It is less than adequate that a startup test procedure was reviewed and approved without containing well defined processes for both these deficiencies, especially explicit directions regarding the documentation of encountered deficiencies and the process for disposition of these deficiencies.

Recommendation: NWP should examine their Technical Procedure review and approval process since it does not appear to have the necessary rigor to identify basic deficiencies in a startup testing procedure (see Key Element 12-1 for further information).

Safety Management Program Key Elements

During this evaluation, EM-3.112 personnel interviewed each NWP SMP owner with KE responsibility and reviewed performance monitoring data to determine the effectiveness of KE implementation and maintenance. A focus was placed upon the processes NWP utilizes for tracking and trending SMP and KE noncompliances.

Per DOE-STD-3009-2104 section 7.X.3 “*Key elements are those that: (1) are specifically assumed to function for mitigated scenarios in the hazard evaluation, but not designated an SAC; or, (2) are not specifically assumed to function for mitigated scenarios, but are recognized by facility management as an important capability warranting special emphasis. It is not appropriate for a key element to be identified in lieu of a SAC (see Section A.12). The basis for selection as a key element is specified, including detail on how the program element: (1) manages or controls a hazard or*

hazardous condition evaluated in the hazard evaluation; (2) affects or interrupts accident progression as analyzed in the accident analysis; and (3) provides a broad-based capability affecting multiple scenarios.”

WIPP TSR section 5.4.2, *TSR Violation*, states “Violations of a TSR occur as a result of the following criteria:

4. Programmatic breakdown of a PAC (or SMP by reference)

Note: Determination of a programmatic breakdown is determined by tracking and trending noncompliances and deviations, including KEs. A single non-compliance would not necessarily constitute a TSR violation. To qualify as a TSR violation, the failure to meet the intent of the referenced program is significant enough to render the DSA summary invalid.”

WIPP TSR section 5.6.1, *Safety Management Programs*, states “TSR violations with regards to the KEs only occur in the event of programmatic breakdown of the SMP. That is, a programmatic breakdown is determined by tracking and trending noncompliances and deviations.” Section 5.6.1 also states “The SMP owners SHALL ENSURE the KEs and overall safety function of an SMP are implemented and maintained. Management SHALL ENSURE facility-level assessments are performed according to WP 15-CA1004 as part of the continuous improvement process of the Integrated Safety Management System.”

Clearly, the TSRs require NWP to track and trend SMP/KE noncompliances and deviations. The following evaluation details the sufficiency of NWP’s SMP KE tracking and trending mechanisms as well as providing recommendations which should be considered to ensure the KEs are adequately implemented and maintained.

Radiation Protection

- KE 7-1: Proper placement and operation of Continuous Air Monitors (CAMs)

CAM operations issues (e.g. low flow alarms, battery issues) are tracked for trending purposes in Performance Indicator (PI) ESH-04-017, *Airborne Radioactive Events*; however, the PI doesn’t provide goal and/or performance goals for CAM operations as it does for CAM alarms. There are no PIs or metrics associated with proper CAM placement.

- KE 7-2: Control access and entrance to RH hot cells

RH is not an authorized activity, thus not implemented.

- KE 7-3: Contamination control to address potential upcasting from the UG.

Provisions to address upcasting are in place; however, there are no PIs or metrics associated with upcasting. Supplemental Ventilation System operation will require a CAM to be placed at the Salt Station to monitor for potential contamination exhausting into the Salt Shaft.

Hazardous Material Protection

- KE 8-1: Establish provisions to monitor and control air quality to ensure underground workers are protected from volatile organic compounds (VOCs); protective measures include posting hazardous areas, establishing monitoring requirements, ensuring local ventilation, and requiring personnel protective equipment such as respiratory protection as needed.

In April 2017, NWP implemented a new PI ESH-10-2017, *Volatile Organic Compound Data*, which monitors data compiled from real-time instantaneous readings, Short Term Exposure Limit (STEL) 15 minute average, and personal badge Time Weighted Average (TWA) Occupational Exposure Limit (OEL) VOC exposures. The PI has progressive goals and performance flags for STEL or TWO potential exposures; real-time readings are for information only.

Initial Testing, In Service Surveillance, and Maintenance

- KE 10-1: Development and implementation of In Service Inspections for DFs.

There are no PIs or metrics addressing the In Service Inspection (ISI) process. NWP has developed PI ENG-05-2017, *System Health Reports*, which monitors the completion of System Health Reports (SHR). The PI includes goals and performance flags for the completion of scheduled SHRs during the month scheduled. While ISI results are factored into SHRs, the PI does not address ISI implementation.

- KE 10-2: Testing, calibration, operability and preventive/corrective maintenance in accordance with applicable code requirements, manufacturer recommendations, established technical requirements, and engineering judgement consistent with tracking, trending and failure history.
 - There are no PIs or metrics addressing the initial testing program.
 - In-service testing, calibration, operability, and preventive/corrective maintenance for safety significant (SS) structures, systems, and components (SSC), are monitored by PIs OPS-02-2017, *Periodic Maintenance (PM) Performance*, OPS-03-2017, *Corrective Maintenance Open Backlog (Leading) & Mission Critical*, OPS-04-2017, *Corrective Maintenance Work Order Age (3A and above)*, and OPS-08-2017, *SS System Availability*. Goals and performance flags have been developed for OPS-02-2017 and OPS-03-2017; there are no goals or performance flags for OPS-04-2017.
 - However, in addition to SS SSCs, DSA Chapter 10 is applicable to other systems that perform important defense-in-depth functions; equipment

relied on for the safe operation, safe shutdown of the nuclear facility, and for maintaining the facility in a safe shutdown condition as documented in the safety basis (e.g., DSA); and safety support systems meet their functional requirements and performance criteria such that the WIPP operations have reasonable assurance SSCs fulfill the normal and safety functions described in this DSA. There are no PIs or metrics which address in-service testing and calibration, preventive maintenance, or corrective maintenance for these systems. EM-3.112 recommends NWP evaluate WIPP-021, *Hazards Analysis for the Waste Isolation Pilot Plant Transuranic Waste Handling Safety Basis* for defense-in-depth SSC identification and DSA Chapter 4, *Safety Structures, Systems, and Components*, for credited SSC interfacing systems.

- KE 10-3: Tracking and trending of the performance and deficiencies of the equipment covered by KE 10-2 above.
PIs OPS-02-2017, OPS-03-2017, and OPS-04-2017 have been developed; however these PIs only monitor PM and CM status for SS SSCs, thus the same weakness detailed in KE 10-2 applies to KE 10-3 as well. PI ENG-04-2017, *Plant Systems*, addresses 12 systems which NWP determined are needed for safe and efficient operations; however, the 12 systems don't include all systems applicable to Chapter 10. This PI tracks and trends issues impacting each of the 12 system's health and identifies actions which if completed would result in improved system health. Goals and performance flags have been developed for this PI. This is a very good process which should be applied to all SSCs within Chapter 10's scope.

Operational Safety

- KE 11-1: Routine maintenance and inspection of non-waste handling vehicles in the UG for leaks and accumulation of combustibile materials (fire protection).

There are no PIs or metrics developed for this KE.

- KE 11-2: Formal FPE combustibile control inspections to include inspection criteria, specified frequency of inspections, documentation of identified issues, issue disposition, tracking and trending of issues, and performance metrics.

A new PI, OPS-12-2017 *FPE Combustibile Control Inspection Deficiencies (KE 11-2)*, has been developed which monitors new combustibile control deficiencies identified along with those previously identified which were closed on a monthly frequency. Goals and performance flags have not been identified for this PI, thus it is unclear how the PI meets the KE's requirements for tracking and trending and performance metrics. WP-12-FP3009, *Fire Protection Engineering Combustibile Control Program Inspections*, identifies quantifiable combustibile control deficiency thresholds; however, exceedance of the thresholds merely resulted in submitting a WIPP form for causal analysis.

- KE 11-3: Operability and testing of equipment (audible, visual) used for abnormal event communication/notification between workers (both aboveground and in the UG) and the Central Monitoring Room (CMR).

PI OPS-12-2017, *Emergency Notification Systems – Corrective Maintenance Backlog*, was developed in February 2017 and monitors the age of all CM work orders for WIPP’s emergency notification systems. At the time of this evaluation, goals and performance flags have not been identified for the PI; however, the NWP intends to revisit these once sufficient data has been compiled to develop meaningful goals and flags. Although providing useful information, the PI does not address system operability or testing.

- KE 11-4: Placement of fuel barrier of absorbent materials at the static Waste Face when waste emplacement or retrieval has not occurred for a period of 10 days.

There are no PIs or metrics developed for this KE.

- KE 11-5: Fire prevention/suppression controls include the following KEs:
 - Underground diesel powered equipment is evaluated for fire risk in accordance with NFPA 122. All equipment determined to pose an unacceptable fire risk in the NFPA 122 analysis will be protected with an automatic fire suppression system prior to use.

Although NWP has data demonstrating which of the UG’s diesel powered equipment has been evaluated for fire risk, the status of installing and placing into service automatic fire suppression systems on the equipment posing unacceptable fire risk, and which pieces of equipment have been tagged out-of-service, there are no PIs or metrics developed for this KE.

- Areas in the UG where there is an increased combustible loading (e.g., refueling station, maintenance shop, combustible storage area, maintenance offices, lunch room, oil storage area) will be protected by automatic fire suppression systems.

Although NWP has data demonstrating which of the UG’s areas have increased fire loading along with the status of installing and placing into service automatic fire suppression systems for these areas, there are no PIs or metrics developed for this KE.

- Ignition sources (e.g., hot work, designated smoking areas, portable heaters, electrical equipment) are controlled in accordance with the WIPP FPP and Design Control Program.

There are no PIs or metrics developed for this KE.

- Underground combustible materials are controlled in accordance with the WIPP FPP (e.g., combustible control zone around personnel conveyances, combustible load permit process).

See KE 11-2 discussion.

- KE 11-6: Hoisting and Rigging Program which protects safety Structures, Systems, and Components (SSCs), waste packaging, and personnel from dropped loads.

There are no PIs or metrics developed for this KE.

- KE 11-7: Mine entrance requirements impacting personnel safety (e.g., Continuous Air Monitor (CAM) operation, radiological conditions, ventilation capabilities, personnel training, personnel limits for in service conveyances, back-up power).

The KE monitoring table provided by NWP notes this KE is addressed by a combination of several PIs including ESH-01-2017, *Number of Skin/Clothing Contamination Events*; ESH-04-2017 (see KE 7-1); ESH-06-2017, *Timely MSHA Closures*; ESH-09-2017, *Percent Satisfactory Permit Inspections*; ESH-10-2017; and ENG-04-2017 (see KE 10-3 discussion). Goals and performance flags have been developed for PIs ESH-01-2017, ESH-06-2017, ESH-09-2107, and ESH-10-2017.

- CAM operations (see KE 7-1).
- UG ventilation capabilities are sufficiently monitored by ENG-04-2017.
- EM-3.112 recommends adding ESH-05-2017, *Number of MSHA Citations Per Quarter*, to the table as it monitors personnel hoisting deficiencies; adding OPS-05-2017, *Underground Availability and Efficiencies*, to the table as it monitors the percentage of time the UG was available to maximum entrants; and adding the weekly ground control data provided by John Vandekraats to the PIs. Coupled with ESH-06-2017 and ESH-09-2017, this additional information presents a much more complete representation of the UG's health.
- Radiological conditions are not fully monitored by ESH-01-2017 and ESH-04-2017 which monitor skin/clothing contamination and CAM alarms/operability respectively. The combination of these PIs does not monitor contamination, high contamination, or airborne radioactivity footprints or levels.
- Back-up power, system ED09, is not one of the twelve systems monitored by ENG-04-2017, thus there are no PIs or metrics addressing this KE component.
- There are not PIs or metrics developed to monitor mine entrance training requirements or the status of completed mine entrance training.

- KE 11-8: Mine evacuation requirements (e.g., unobstructed planned escape routes, mine exit markings, communications, Abnormal Operations Procedures).

The KE monitoring table provided by NWP notes this KE is addressed by EMS-02-2017, *Drills and Exercises Scheduled and Conducted*, which monitors the percentage of drill conducted vs those scheduled; however, this PI does not monitor the KE's components.

- EM-3.112 recommends adding ESH-05-2017, *Number of MSHA Citations Per Quarter*, to the table as it monitors MSHA citations for travel/escape ways, ground control, and illumination. Goals and performance flags have been developed for this PI. EM-3.122 also recommends this MSHA data be complemented with deficiencies identified by NWP, CBOF, and other organizations to present a complete representation of compliance with mine evacuation requirements.
 - Communications is addressed in KE 11-3's discussion.
 - There are no other PIs or metrics developed to address Abnormal Operations Procedures
- KE 11-9: Equipment deficiency tracking (including equipment in reduced status) that identifies, tracks, and evaluates safety impacts and implements compensatory measures until equipment is returned to service.
 - See KEs 10-2 and 10-3 for discussion regarding corrective maintenance backlog and work order age for SS SSCs along with SS SSC availability. The PIs do not monitor associated compensatory measure determination and implementation. Shift Operations Manager maintain the status of most of the plant's systems along with identified compensatory measures, but this information is not tracked and trending as part of this KE implementation and maintenance.
 - See KE 10-3 for discussion regarding the status of the 12 systems identified by NWP as needed for safe and efficient operations.
 - Fire protection system impairments are addressed by OPS-09-2017, *Fire Protection/Detection Impairments*, which monitors the number of open impairments and average impairment age; however, the PI does not monitor associated compensatory measure determination and implementation. Fire protection system deficiencies are addressed by OPS-10-2017, *Open Fire Protection Deficiencies (Legacy/Non-legacy)*, which monitors the number of fire suppression, alarm detection, and fire/life safety deficiencies; however, the PI does not monitor associated compensatory measure determination and implementation. Goals and performance flags have not been developed for these PIs.
 - KE 11-10: Ground control inspections are conducted routinely, and remedial actions performed for unstable ground conditions by qualified personnel.

Aside from the MSHA identified ground control citations contained in ESH-05-2017, there are no PIs identified for this KE. However, updated ground data and metrics are presented to NWP and CBFO on a weekly basis by John Vandekraats. These provide information regarding bolting progress, bolter availability, and shifts during which scaling and/or broken bolt mitigation occurred. There are no PIs or metrics developed which monitor the conduct of ground control inspections.

- KE 11-11: Maintenance and configuration control of ground control equipment.
 - See KEs 10-2 and 10-3 for discussion regarding corrective maintenance backlog and work order age for SS SSCs along with SS SSC availability; however, this is not applicable to ground control equipment with the exception of SS fire suppression systems for UG liquid fueled waste handling equipment or liquid fueled vehicles with the potential for being within 25 feet of CH waste.
 - Bolter availability is monitored in weekly updated ground control metrics. See KEs 11-9 and 11-10 discussions for additional detail.
- KE 11-12: Procedures address the actions to be performed by operators in response to CMR notifications, annunciators, and other types of facility displays that indicate an abnormal condition.

There are no PIs or metrics developed for this KE.

Procedures and Training

- KE 12-1: Preparation of procedures related to safe operation of the facility and/or safety Structures, Systems, and Components (SSCs) with participation by end users and appropriate subject matter experts, verified to be technically correct, validated to be workable as written.
 - NWP has developed four metrics for this KE: 1) overdue procedure periodic review, 2) verification and validation (V&V) percentage breakdown, 3) procedure change request, and 4) field revision percentage. Goals and performance flags have not been developed for these metrics.
 - These metrics identify two significant negative trends: 1) the number of overdue periodic review has steadily increased from 20 in January 2017 to 76 in May 2017, and 2) the ratio of tabletop V&Vs versus field V&V for new procedures/procedure changes averaged over 2:1 from January 2017 through May 2017 (May data shows there were more field V&Vs than tabletops for the month). Field V&Vs are known to be more effective, thus it's unclear why line managers with the ability to opt for and approve tabletops were doing so. In order to improve the V&V process, NWP has revised its V&V checklist, requires personnel to complete V&V training

prior to participation, and require procedure writers to participate in the V&V activities.

- While the first two metrics address the KE, EM-3.112 recommends a metric which monitors the need for a procedure change (e.g. process change, inadequate preceding version, etc.) in order to better evaluate the sufficiency of its procedure development/change processes.
- KE 12-2: Worker training and qualifications on responding to incidents (e.g., use of rescue equipment, assembly areas).

NWP has developed a metric for this KE which monitors training classes delivered against classes scheduled, cancelled classes, special classes, one-on-one classes delivered against classes requested, classes with less than four students, training extensions, and no-shows for scheduled training classes. While this is a worthwhile metric for training class delivery, it does not address the KE.

- KE 12-3: Training and qualification programs are designed and developed to ensure personnel obtain initial requisite knowledge and skills resulting in abilities to effectively execute assigned duties during normal, abnormal, and emergency conditions. Continuing training is provided to maintain requisite knowledge and skills as warranted for changes such as emergent Evaluation of the Safety of the Situation (ESS) documents. Personnel are not permitted to perform assigned duties independently until requisite training and qualification are complete.

There are no PIs or metrics developed for this KE. NWP develops a training profile for all positions identified in the Training Implementation Matrix (TIM). The profile is populated with training and qualification status for personnel serving in those positions and detailed on the Qualified Watch-standers List (QWL). The QWL includes flags demonstrating training and qualification status (green – qualified to stand the watch, yellow – qualified, but something within training profile is due within the forthcoming month, and red – not qualified to stand watch) and is readily available for supervision and workforce personnel. The QWL is a valuable tool to verify personnel training and qualification status; however, it is not a tracking and trending metric such as percentage of personnel assigned to a position against those qualified to stand watch. Additionally, there are not PIs or metrics which monitor continuing training.

Quality Assurance

- KE 14-1: Password protection of Safety Significant (SS) Programmable Logic Controllers.

There are no PIs or metrics developed for this KE.

Emergency Preparedness

- KE 15-1: Hazards are identified and analyzed through a technical planning basis process to provide pre-determined protective actions and Protective Action Recommendations to protect workers and the public.

There are no PIs or metrics developed for the KE; however, the KE can be met via a DOE approved Emergency Preparedness Hazards Assessment which is currently implemented. It does not appear there would be any value in tracking and trending the implementation and maintenance of this KE.

- KE 15-2: Emergency plans and procedures provide the framework for actions to be taken by workers and responders.

There are no PIs or metrics developed for this KE.

- KE 15-3: Emergency response capabilities (e.g., operable equipment, minimum staffing, Incident Command System, Emergency Operations Center) are identified and maintained to respond and protect workers, public, property, and environment.

- Emergency response staffing and qualifications are sufficiently addressed by PIs EMS-01-2017, *Emergency Operations Center-Training and Qualification-Total Qualified & Fully Staffed Positions (3 Deep)*, and EMS-04-2017, *Emergency Response Organization (ERO) Qualified Watch Standers*. Goals and performance flags have been developed for each of these PIs.
- There are no PIs or metrics addressing emergency response equipment operability. The Emergency Preparedness (EP) SMP owner issued WIPP Form 17-715 after discussion with EM-3.112 which recommends an action to develop a metric which will measure the readiness of first line emergency response equipment. This metric will be included in the monthly EP SMP health report.
- There are no PIs or metrics addressing emergency response minimum staffing. The EP SMP owner issued WIPP Form 17-858 which recommends an action to develop a metric which will monitor how often fire department staffing falls below minimum staffing requirements.

- KE 15-4: Emergency drills and exercises are planned and conducted to provide validation of plans, procedures, and response capabilities.

Emergency drill and exercise planning and execution are sufficiently addressed by PI EMS-02-2107, *Drills and Exercises Scheduled and Conducted*, which monitors the number of no-notice drills conducted, scheduled drills conducted, rescheduled drills, and drills not conducted on a monthly basis. This PI includes goals and performance flags.

Management, Organization, and Institutional Safety Provisions

- KE 17-1: Configuration management of Structures, Systems, and Components (SSCs) identified in accordance with DOE Order 433.1B, *Maintenance Management Program for DOE Nuclear Facilities*.

SSC configuration management is addressed by PIs ENG-01-2017, *Engineering Change Order (ECO) Work Off Status*, ENG-02-2017, *Engineering Change Notice (ECNs)*, ENG-03-2017, *Document Change Notice (DCNs)*, and ENG-05-2017, *System Health Reports (SHR)*. However, given the issues identified in KE 10-2 discussion, EM-3.112 recommends that NWP applies the KE 10-2 recommendation to this KE.

WIPP Waste Acceptance Criteria Compliance

- KE 18-1: The WIPP M&O Contractor verifies each container is part of an approved waste stream with the enhanced Acceptable Knowledge process prior to authorizing shipment in WDS.

There are no PIs or metrics developed for this KE; however, this verification should be addressed by a Waste Data System limit check.

- KE 18-2: The WIPP M&O Contractor reviews approved WSPFs to verify the information provided is complete and accurate, and that the waste stream complies with Hazardous Waste Facility Permit (HWFP) Waste Analysis Plan (WAP) and the WIPP Waste Acceptance Criteria (WAC) (DOE/WIPP 02-3122, *Transuranic Waste Acceptance Criteria for the Waste Isolation Pilot Plant*) prior to authorization for shipment.

There are no PIs or metrics developed for this KE; however, this verification should be addressed by a Waste Data System limit check.

- KE 18-3: The WIPP M&O Contractor verifies the HWFP requirement for confirmation of certified waste prior to shipment to the WIPP from the DOE Sites.

There are no PIs or metrics developed for this KE; however, this verification should be addressed by a Waste Data System limit check.

- KE 18-4: The WIPP M&O Contractor performs Generator Site Technical Reviews, which are reviews of DOE Sites' and Certified Programs' implementation of WIPP requirements (excluding DOE activities).

There are no PIs or metrics developed for this KE. EM-3.112 recommends PIs and/or metrics which monitor completed Generator Site Technical Reviews (GSTR) against scheduled GSTRs, sufficient closure of corrective actions associated with GSTR identified issues, and independent review of GSTR sufficiency.

- KE 18-5: The MAR statistics for waste certified for future shipment to WIPP are reviewed periodically by the WIPP M&O Contractor (no less frequently than annually) to ensure the values stated in Tables 3.4-1 and 3.4-2 (based on DOE-STD-5506 statistical analysis methodology) continue to provide conservative, unmitigated consequences in the Safety Analysis; further, each payload proposed for shipment to WIPP is additionally screened to ensure handling and emplacement of small groupings of containers will remain bounded by the Safety Analysis.

There are no PIs or metrics developed for this KE. However, NWP evaluates each proposed payload against the statistical material at risk (MAR) criteria prior to authorizing shipment. At the time of this evaluation, the annual evaluation for forthcoming certified waste shipments has not been completed.

Recommendations:

- Develop discrete performance indicators/metrics for all KEs. EM-3.112 will provide recommended performance indicators/metrics by the end of September 2017 for those KEs which don't have them.
- Develop discrete WIPP Form Codes to align with KE implementation sufficiency
- Revise WP 15-CA1004 to specifically address KE evaluation
- Require ESQRB SMP presentations include KE tracking and trending data demonstrating evaluation of the KE's implementation and maintenance.
- Develop mandatory SMP and KE training for all NWP ESQRB members and authorized alternates
- Ensure KEs 10-2, 10-3, and 17-1 address all systems applicable to DSA chapter 10 are addressed by performance indicators/metrics. This should include evaluation of WIPP-021, *Hazards Analysis for the Waste Isolation Pilot Plant Transuranic Waste Handling Safety Basis* for defense-in-depth SSC identification and DSA Chapter 4, *Safety Structures, Systems, and Components*, for credited SSC interfacing systems.
- Apply PI ENG-04-2017 methodology to all SSCs within DSA Chapter 10's scope
- Include PI ESH-05-2017, PI OPS-05-2017, and the weekly ground control data provided by John Vandekraats to the to the KE monitoring table for KE 11-7.
- Develop a KE 12-1 metric which monitors the need for a procedure change (e.g. process change, inadequate preceding version, etc.).
- Ensure KEs 18-1, 18-2, and 18-3 are addressed by WDS limit checks
- Develop PIs and/or metrics which monitor completed Generator Site Technical Reviews (GSTR) against scheduled GSTRs, sufficient closure of corrective actions associated with GSTR identified issues, and independent review of GSTR sufficiency.
- Enhanced independent oversight by NWP for KE implementation and maintenance

