

**Office of Enterprise Assessments
Assessment of Conduct of Engineering at the
Waste Isolation Pilot Plant**



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Acronyms

AR/VR	Approval Request/Variance Request
BOP	Balance of Plant
CBFO	Carlsbad Field Office
CFR	Code of Federal Regulations
CH	Contact Handled
CM	Configuration Management
CSE	Cognizant System Engineer
DCN	Document Change Notice
DOE	U.S. Department of Energy
EA	Office of Enterprise Assessments
ECN	Engineering Change Notice
ECO	Engineering Change Order
EDMS	Electronic Document Management System
ETO	Evaluation of Technical Operability
HEPA	High Efficiency Particulate Air
LCO	Limiting Condition for Operation
MLD	Management Level Determination
MVS	Mine Ventilation Services
NQA	Nuclear Quality Assurance
NWP	Nuclear Waste Partnership, LLC
OFI	Opportunity for Improvement
SDD	System Design Description
SHR	System Health Report
SRK	SRK Consulting
SS	Safety Significant
SSC	Structure, System, or Component
SSO	Safety System Oversight
SVS	Supplemental Ventilation System
TRU	Transuranic
TSR	Technical Safety Requirement
WHB	Waste Handling Building
WIPP	Waste Isolation Pilot Plant

Office of Enterprise Assessments
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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), performed an assessment of conduct of engineering at the Waste Isolation Pilot Plant. The purpose of this EA assessment effort was to evaluate the effectiveness of engineering processes and programs implemented by the facility contractor, Nuclear Waste Partnership, LLC (NWP). This assessment is a follow-up to an EA review of engineering and procurement, documented in EA report *Review of Waste Isolation Pilot Plant Engineering and Procurement Processes*, dated November 2015.

This assessment examined engineering process improvements implemented by NWP since the earlier review and included a review of technical products created using the updated processes. EA also examined the cognizant system engineer program, the configuration management program, and the issues management program as implemented within the engineering organization. Finally, EA followed up on findings identified in previous reviews of engineering processes and programs to assess the efficacy of corrective actions taken in those areas.

EA identified two areas where NWP Engineering activities and processes constitute best practices worthy of emulation on other DOE projects:

- NWP Engineering has developed a process for defining technical inputs and functional requirements in advance of significant facility design changes, applying that process at a more granular level than observed at other DOE facilities. The process includes identification of inputs, regulatory requirements, performance requirements, constraints, and system interfaces, resulting in a more effective modification process.
- NWP has instituted a formal process for in-service inspection of design features credited in the facility safety basis. This process recognizes that even passive safety features may be subject to degradation or deterioration over time, and that monitoring is needed to confirm continued capability to perform intended safety functions.

EA also identified positive attributes in several other areas that show improved performance since the 2015 assessment:

- NWP has enhanced several key engineering procedures and prepared a new procedure for temporary modification control.
- NWP Engineering has augmented processes for calculations and for design changes with new requirements that ensure tracking and closure of open items before return to service.
- Design change packages reviewed during this assessment exhibited notable quality improvements compared with previous reviews.
- NWP internal assessments of the engineering organization were rigorous and effective in driving organizational improvement.
- The cognizant system engineer program is robust, with system engineers assigned to both safety-related and non-safety systems.

The contractor oversight program within the Environmental Management Carlsbad Field Office Facility Engineering Division is well-structured and active, both in monitoring safety-related activities and in working with contractor engineering to improve performance. As part of the scope of this assessment, EA followed up on six findings from previous reviews of engineering processes and programs. NWP Engineering's corrective actions to date have been sufficient to resolve four of the six. The corrective

actions for one of the other two were ineffective, and the last one has been partially addressed but requires further long-term actions to fully resolve.

No new findings resulted from this assessment. However, EA identified a few deficiencies, mostly process-related: (1) The design change procedure does not require any technical basis or justification for a change; (2) The calculation procedure allows calculations to be issued as part of other documents, creating the potential for loss of design control under some conditions; (3) Design verification requirements for calculations have not been adequately proceduralized; (4) None of the seven vendor calculations and technical products that EA reviewed complied with procedural requirements; (5) Five of nineteen internally produced calculations contained errors; (6) one technical operability evaluation was based on invalid assumptions; (7) NWP has not adequately resolved a prior finding on document management and availability of engineering records; and, (8) system engineer walkdown requirements to verify facility physical configuration were eliminated in a procedure revision, resulting in non-compliance with DOE Order 420.1C, *Facility Safety*. This last issue is of concern because WIPP has experienced repetitive problems with configuration management.

Overall, EA noted improvements since the previous assessment in 2015 in several areas (e.g., procedures, design changes, issues management), including overall engineering performance. Addressing the deficiencies documented here will lead to further engineering program improvement.

Office of Enterprise Assessments
Assessment of Conduct of Engineering at the Waste Isolation Pilot Plant

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), performed an assessment of conduct of engineering at the Waste Isolation Pilot Plant (WIPP). The purpose of this EA assessment was to evaluate the effectiveness of engineering processes and programs implemented by the facility contractor, Nuclear Waste Partnership, LLC (NWP). This assessment is a follow-up to an EA review of engineering and procurement documented in EA report *Review of Waste Isolation Pilot Plant Engineering and Procurement Processes*, dated October 2015.

EA performed this assessment of WIPP from July 10 through August 3, 2017. This report discusses the scope, background, methodology, results, and conclusions of the assessment, as well as the opportunities for improvement (OFIs) identified by the review team.

2.0 SCOPE

This assessment evaluated the procedures that implement WIPP engineering processes, along with a representative sampling of engineering deliverables produced under those processes. EA also assessed the cognizant system engineer, configuration management, and issues management programs as implemented within the engineering organization. Finally, EA followed up on issues identified in previous reviews to assess the efficacy of corrective actions taken in those areas. This review scope was in accordance with the *Plan for the Office of Enterprise Assessments Assessment of Conduct of Engineering at the Waste Isolation Pilot Plant*, dated July 2017.

3.0 BACKGROUND

WIPP is a hazard category 2 facility near Carlsbad, New Mexico, constructed for the purpose of geological disposal of transuranic wastes generated at other DOE facilities. The contractor engineering group is charged with defining and maintaining the technical baseline for the facility, and supporting both operations and maintenance. Unlike other DOE facilities, contractor activities at WIPP must include a focus on mine safety in addition to nuclear and industrial safety concerns.

NWP is responsible for operation of the facility, and the Carlsbad Field Office (CBFO) performs Federal oversight.

This assessment is part of a series of reviews in various functional areas established by EA in coordination with CBFO in response to issues identified at WIPP following two emergency events in 2014. Several limited-scope engineering reviews and a full assessment of engineering and procurement in 2015 identified a number of recommended process improvements. This assessment revisited those issues to gauge progress and to assess the overall health of the engineering program.

4.0 METHODOLOGY

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

As identified in the assessment plan, this assessment considered requirements related to conduct of engineering. EA used the criteria and lines of inquiry for successful conduct of engineering identified in EA Criteria and Review Approach Document 31-13, *Conduct of Engineering*, to examine contractor and field office performance.

EA examined key documents, such as system descriptions, calculations, procedures, manuals, design change packages, policies, training and qualification records, and numerous other documents. EA also interviewed key personnel responsible for developing and executing the associated programs; observed cognizant system engineer activities; and walked down portions of selected facilities. 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 conclusions of this report, is provided in Appendix B.

This assessment also examined the completion and effectiveness of corrective actions resulting from the findings of the 2015 EA review. Results of the corrective action assessments are discussed in the appropriate subsections of Section 5.0, Results, of this report.

5.0 RESULTS

5.1 Design Engineering Processes

This section discusses EA’s assessment of the processes in place within the NWP Engineering organization to perform engineering functions. Since EA examined most of these processes in 2015, the current assessment focused on improvements since that time. One process revision affected the engineering design change process: the replacement of Engineering Change Orders (ECOs) with Engineering Change Notices (ECNs). The documents reviewed and discussed in the following sections included both ECOs and ECNs. For clarity, the remainder of this report uses the term “change package” to refer to both ECOs and ECNs when not referring to specific document numbers.

Objective:

Design engineering work is performed consistent with technical standards, DOE requirements, and safety basis requirements and commitments, using approved procedures and sound engineering/scientific principles in accordance with the requirements of 10 CFR 830.

Criteria:

- *Engineering procedures are in place and contain appropriate detail to control development, approval, issuance, and revision of deliverables, as well as key processes essential to the design engineering function. (10 CFR 830)*
- *Engineering procedures provide barriers against poor performance, require participation and review by appropriate organizations, and drive communication between distinct groups. Verbatim compliance is required. (10 CFR 830)*

EA reviewed engineering processes for many primary engineering design functions, including preparation and approval of drawings, calculations, and design change packages. In most areas, the processes reviewed provide adequate guidance to accomplish the subject activities in a technically acceptable, controlled manner. The results for those processes are briefly summarized below:

- WP 09, *Conduct of Engineering*, provides an adequate overview of engineering roles and responsibilities, and a basic introduction to key engineering processes such as configuration management (CM). It has been augmented since the previous assessment with well-defined, position-based training requirements for engineering personnel.
- WP 09-CN3003, *As-Built Drawings: Process and Control*, defines the process for validating existing drawings against the field configuration. Only minor changes have been made since the previous EA assessment, and no new issues were noted.
- WP 09-CN3044, *Developing Technical and Functional Requirements*, is a relatively new procedure that defines a process for determining requirements to be met in the development of key plant design changes, including major modifications. It requires the preparer to identify design inputs, regulatory requirements, performance requirements, constraints, system interfaces, and other appropriate factors in advance of design execution. EA considers use of this process to enhance effectiveness of the modification process at WIPP to be a **Best Practice**.
- WP 09-CN3018, *Design Verification*, is generally adequate in defining the design verification process for engineering change packages. However, because it does not contain requirements specific to calculations or other types of engineering documents, the application of design verification requirements for calculations embedded in change packages has been inconsistent. (See **OFI-NWP-1**.)
- In the past, NWP has used the engineering change process to make temporary modifications to the facility, requiring one change package to install the temporary modification and another change package to remove it. A recently approved new procedure, WP 09-CN3046, *Temporary Plant Modification Control* (discussed further in Section 5.3 of this report) establishes a standalone temporary modification process, representing a substantive improvement in this area.

WP 09-CN3007, *Engineering Change Notice*, details the design change process. Since the previous EA review, the change process has been enhanced by the addition of requirements to verify closure of any open items carried forward during issuance of a change package, thereby establishing a process barrier to prevent return to service of structures, systems, or components (SSCs) having unresolved issues. WP 09-CN3007 requirements for design verification are also well-coordinated with the design verification procedure discussed above.

However, NWP has not effectively addressed the previous EA finding that earlier revisions of this procedure did not require documentation of the technical basis for the changes being made (cited as previous Finding 2 in Section 5.6 of this report). In response to the EA finding, NWP initiated corrective action document (WIPP Form) 15-474 and revised the procedure (revision 46) to require documentation of the technical basis for the change in the change package or by reference. During the current assessment, EA found that revision 48 of this procedure does not include this requirement and that the associated WIPP Form 15-474 had been closed. (**Deficiency**)

NWP has no dedicated procedure for engineering drawings. WP 09-CN3007 covers numbering and revision via the ECN process but does not address incorporation of changes or the update process. WP 09-11, *NWP Configuration Management Plan*, contains update requirements for essential and support categories of drawings, defines those categories, and contains a table that defines most types of drawings as either essential or support. Neither procedure limits the number of changes that may be outstanding against a drawing in either category before incorporation is mandated, although interviews indicated that updates are generally initiated after reaching an informal limit of five changes. (See **OFI-NWP-2**.)

The calculation procedure, WP 09-CN3031, *Engineering Calculations*, has been enhanced since the previous EA assessment. It now includes specific requirements for tracking unverified assumptions, or open items, in the Commitment Tracking System, which is a limited access tracking tool that provides automated due date notifications to the originating individuals for items in open status. The current process also adequately addresses numbering of calculations, and a controlled calculation log is available to correlate calculations with the engineering change packages they support. WP 09-CN3031 generally meets the requirements of Nuclear Quality Assurance (NQA)-1 and is adequate to support the calculation process, with three exceptions:

- WP 09-CN3031 permits calculations to be issued as part of other documents, such as change packages or operability evaluations. Most calculations are issued in this manner, rather than as standalone documents. This approach has resulted in design control issues, because if multiple change packages are issued over time for a SSC, each package contains a new calculation; thus, multiple calculations are issued and available for access, each one developed for the same purpose, with no cross references and with differing results based on differing inputs. Design control is a key aspect of CM as defined in DOE Order 420.1C, *Facility Safety*, and DOE STD-1073-2003, *Configuration Management*. Standard industry practice is to issue calculations as standalone documents and revise them as necessary to support design changes, resulting in maintenance of a single source for that scope of design output. (**Deficiency**)
- WP 09-CN3031 does not adequately address design verification of calculations embedded in change packages, either by reference to the design verification procedure discussed above or through direct content. There is no exemption from design verification requirements for balance of plant (BOP) or management level determination (MLD)-4 calculations; however, out of 36 change packages reviewed, EA identified the following calculations inside change packages that contained no evidence of having been design verified: (**Deficiency**)
 - In ECO 13891, *Installation of Additional HEPA [high efficiency particulate air] Filter Differential Pressure Instrumentation*, a design review process had been used for the change package, but the design review information included in the package gave no indication that the review process had addressed calculation CALC-16-008, *Uncertainty of Mechanical Gauges for Differential Pressure Measurement Across HEPA Filter Banks*, which was in the package. The calculation did not contain any separate indication that design verification had been performed. The calculation is safety significant (SS).
 - ECO 13919, *Add Anchor Bolt Requirements to TRUPACT Lid Stand Drawings*, contains two calculations, neither of which exhibits evidence of design verification. One is shown as MLD-4 and the other is BOP.
- WP 09-CN3031 does not reference or point to procedure WP 09-12, *Evaluation of Technical Operability [ETO] Adequacy of Facility Systems, Structures, and Components*, for cases when the conclusions of the calculation may require an operability screen and require the cognizant engineer to consider initiating the operability evaluation process. (See **OFI-NWP-3**.)

Engineering Process Conclusions

Process improvements were evident in several areas, including conduct of engineering, the design change process, and calculations. EA considered a new process for establishing design inputs and requirements to be a best practice, and the establishment of a standalone temporary modification process through issuance of a new procedure is a substantive improvement. EA identified a needed clarification for the design verification procedure and three areas of weakness in the calculation procedure.

5.2 Engineering Product Technical Review

This section focuses on the quality of engineering technical products created using the processes examined in Section 5.1. In each area, EA selected a limited sample of documents produced within the last one to two years for detailed review.

Objective:

Design engineering work is performed consistent with technical standards, DOE requirements, and safety basis requirements and commitments, using approved procedures and sound engineering/scientific principles in accordance with the requirements of 10 CFR 830.

Criteria:

- *Documents comprising the project technical baseline are readily identifiable and subject to appropriate control measures. System design documents and supporting documents must be identified and kept current using formal change control and work control processes. (10 CFR 830)*
- *Analyses and calculations are prepared with design inputs clearly identified and assumptions technically justified (or unverified assumptions clearly identified and tracked to resolution), prepared consistent with the design criteria and safety basis, and checked by a second party and verified by an independent verifier, as appropriate. (10 CFR 830)*
- *Design drawings are subject to interdisciplinary review as appropriate prior to issuance, accessible and retrievable in the most current version, and in accordance with applicable design criteria and industry standards. (10 CFR 830)*

Calculations

EA reviewed 19 calculations during this assessment, with mixed results as detailed below:

- Twelve of the calculations that were included in issued design change packages did not receive design verification apart from the review performed for the change document. The discussion of WP 09-CN3018 in Section 5.1 concluded that the design verification process for change packages is not adequate for calculations. This problem was evident regardless of the safety classification of the calculation.
- In some cases, NWP relies on subcontractors to prepare design analyses for specialized design subject areas, but does not impose the requirements of NQA-1 or the NWP calculation procedure for subcontractor design documentation submittals. The subcontractor calculations and other document submittals that EA reviewed were not compliant with the requirements of NQA-1-1989, specifically Supplement 3S-1, Section 3.1, which states, in part, that “design analyses shall be performed in a planned, controlled, and documented manner... They shall be sufficiently detailed as to purpose, method, assumptions, design inputs, references, and units, such that a person technically qualified in the subject can review and understand the analyses and verify the adequacy of the results without recourse to the originator.” Contrary to these requirements, the following analyses and documentation exhibited deficiencies related to the NQA-1-1989 requirements: **(Deficiency)**

- The underground air flow analyses performed by SRK Consulting (SRK), formerly Mine Ventilation Services (MVS), were submitted by multiple memoranda that lacked the attributes required by NQA-1-1989. The memoranda do not reference or document whether they supersede or revise previously-issued memoranda, so their applicability to the current design configuration of the underground ventilation system is unclear. Documented safety analysis credited controls and technical safety requirement (TSR) safety-related ventilation limiting condition for operation (LCO) requirements rely on these analyses. Traceability to these analyses and the analysis results is unclear, the analyses are not uniquely identified by calculation number, and the results are not readily retrievable.
- AR/VR 21-1, *SVS Software Change Log*, dated June 8, 2017, was approved to document software updates to the supplemental ventilation system (SVS), but it does not refer to the specific document being changed or to a formal ECN. Consequently, it is not a standalone document and lacks sufficient description of purpose, scope, and applicability.
- CALC-16-011, *Tensile Strength Needed for Bolts on TRUPACT Lid Stand*, erroneously equates kinetic energy with force in calculating impact load on the stand. CALC-16-015, *Force & Velocity of Load CH [contact-handled] Crane Colliding with Lid Stand*, a successor calculation to CALC-16-011, continues this error.
- CALC-15-021, *WHB [Waste Handling Building] Operability Set Points*, (revisions 0, 1, and 2) used a generic handbook value for diesel fuel consumption rate to size the fuel tank. Manufacturer data for diesels similar to the WIPP fire pump diesels indicated that this consumption rate is likely conservative. However, the implicit assumption was not questioned in any revision of the calculation and the calculation did not validate the number used. Furthermore:
 - Revision 1 of the calculation used a different value for the density of water than either revision 0 or revision 2.
 - Revisions 0, 1, and 2 all have incorrect statements, in Section 5.4.3 of the calculation, that contradict the equation used in that section.
 - Revision 0 also has an incorrect equation in Sections 5.1.2 and 5.1.3 of the calculation.
 - Revision 0 of the calculation incorrectly adds the numerical values of pressures in pounds per square inch to those in pounds per square foot in Sections 5.1.2 and 5.1.3. These units are not compatible. **(Deficiency)**
 The details of these problems were provided to NWP.

Although most of the calculations that EA reviewed were technically adequate, the concern implicit in the observations noted above is that the checking/design verification process is not sufficiently rigorous to find errors before the calculations are issued and used in support of a design change or procurement.

Drawings

EA identified no issues in a limited sampling of drawings associated with SVS. EA also found that ten engineering drawings associated with posted operator aids were current. Additionally, EA reviewed selected design change packages associated with recently modified drawings from this group. All changes were appropriately incorporated on the drawings.

Design Change Packages

EA reviewed 36 design change packages, including ECOs, ECNs, and Document Change Notices (DCNs, discussed in Section 5.3 of this report). The change packages were generally in compliance with WP 09-CN3007, with the following exceptions:

- ECOs 13904, 13915, and 13916 had similar scopes, associated with installation of door closers on selected doors in the underground, and addressed different rooms that now have an agent-based fire suppression system installed. Door closers were needed to allow for worker egress, while minimizing

bulkhead openings to allow the suppression agent to work effectively. Each ECO referenced ETO-Z-265, *Evaluate Use of Standard Door Closer Mechanism for Underground Bulkhead Man Doors*. As noted below under “Evaluations of Technical Operability,” ETO-Z-265 contained errors that require further analysis.

- Technical justification for the change was absent in ECO 13933, *Correct Drawing Found On System Walkdown For PC03*, and weak in ECO 13942, *Provide Fire Detection In The High-Efficiency Particulate Air (HEPA) Filter Enclosure Of The Interim Ventilation System (IVS)*, with an abbreviated “structural analysis” that was entirely qualitative.

Despite the identified shortcomings, these results reflect overall improved NWP performance in this area.

Evaluations of Technical Operability

EA reviewed five ETOs, two of which had multiple revisions. Three of the ETOs adequately evaluated their stated objectives. The fourth ETO reviewed, ETO-Z-230, *LCO 3.1.1.1 Set Point Determination Calculation*, had several problems (addressed above in the discussion of the embedded calculation CALC-15-021). The fifth ETO reviewed, ETO-Z-265, *Evaluate Use of Standard Door Closer Mechanism for Underground Bulkhead Man Doors*, was developed to justify the use of a standard door closer for underground man doors in bulkheads. Several ECOs that cited this ETO are addressed above, under “Design Change Packages.” ETO-Z-265 itself has two primary errors that were not detected during the NWP checking and review processes:

- The drift in which ventilation reverses with SVS operation is incorrectly stated as W-170, not W-30.
- The unverified assumption that man doors close in the direction of ventilation flow is not correct in all cases.

With respect to the latter error, EA inspected ten doors for six rooms with an agent-based fire suppression system in the underground and identified three doors for three different rooms where ventilation may prevent the door closer from operating as intended. Two of those doors opened onto W-30, where the SVS will cause flow to reverse. EA provided the location of door hinges and direction of swing to the cognizant system engineer (CSE) for further analysis, since the conclusion of ETO-Z-265 is invalid for these three areas. **(Deficiency)** If the door closers for the three identified rooms do not have sufficient force to close the doors during a discharge of the agent-based suppression system, the agent will be diluted and its ability to suppress the fire will be compromised.

Engineering Product Technical Review Conclusions

EA identified several problems with calculations, including inadequate review/documentation of vendor calculations, undetected errors in calculations performed in-house, and no evidence of design verification for some calculations included in change packages. The drawings and change packages that EA reviewed were adequate, with few exceptions. In particular, change package quality has improved since the 2015 assessment, although one of the ETOs included in the review proved to have inaccurate assumptions that invalidated some of its conclusions.

5.3 Configuration Management and Change Control

The engineering role in CM includes functions associated with creating and maintaining the technical baseline for the facility, controlling the design change process, managing engineering records, and performing self-critical assessments to ensure continued adequacy of performance in these areas. Guidance for these functions is included in DOE STD-1073-2003 and DOE Order 420.1C.

Objective:

A documented configuration management program has been established and implemented in accordance with DOE Order 420.1 that ensures consistency among system requirements and performance criteria, system documentation, and physical configuration of the systems within the scope of the program.

Criteria:

- *Design input and output documents are appropriately established. Requirements from upper tier documents are appropriately incorporated into successor (or lower tier) documents. System design basis documents are kept current using formal change control and work control processes. (DOE STD-1073-2003)*
- *A design change process is in place to ensure that all documents affected by a change, both predecessor and successor, are identified and revised as part of the change process; that changes are reviewed by all potentially affected disciplines and organizations; and that extant changes against technical documents are tracked from initial issuance until incorporation in an approved revision. (DOE STD-1073-2003)*
- *A records management system has been implemented to provide accessibility to engineering documents using a process that defaults to the most recent revision; tracks unincorporated changes outstanding against issued documents; and limits outstanding changes against engineering documents, such as drawings, to avoid negative impacts from excessive change paper and difficulties in determining the current design configuration. (DOE STD-1073-2003)*

The NWP CM program is adequately described in WP 09-11, *NWP Configuration Management Plan*. EA has reviewed the NWP processes for CM in the past, as reported in EA Operational Awareness Records EA-WIPP-2015-03-19 and EA-WIPP-2016-07-12, as well as in EA report *Review of Waste Isolation Pilot Plant Engineering and Procurement Processes*, November 2015. The current EA review included a follow-up assessment of issues identified in those reports and interviews with NWP engineering management, as summarized below, with updates.

Technical Baseline

A previous EA operational awareness review noted that NWP's technical baseline was not clearly defined to include specific design basis documents and did not categorize drawings as essential, support, or general. At that time, NWP planned a revision to correct this omission. The current assessment found that revision 9 of WP 09-11 adequately lists the technical baseline documents, including drawings, and categorizes them as either essential or support.

Engineering Change Control

NWP uses ECNs as the design change method, in accordance with WP 09-CN3007. The ECN process superseded the ECO process with the issuance of revision 47 of the procedure in October 2016. However, older design changes that were in process when that revision was issued are still carried out consistent with the previous ECO process. The newer ECN process is supplemented by two other processes: the DCN process, which is used for certain types of editorial and administrative changes, and the Field Change Notice process, which is used to address changes requested during the construction/field implementation phase and to incorporate as-built information into record drawings. This new process allows for function-specific change control that enables the appropriate amount of rigor during its approval process.

NWP has recently implemented a temporary plant modification control process for facility modifications expected to be installed for six months or less. The new process is adequate, requiring the user to state the technical justification, including review from Operations at the start of process and at the restoration

of the original configuration, and providing for appropriate oversight from the CSE.

Past EA reviews have examined the process of ECO closure, the backlog of ECOs awaiting closure, and the incorporation of changes into drawings. WP 09-CN3007 requires updating of essential and secondary drawings impacted by a change package before that change package can be closed. At the time of the current EA assessment, 32 ECOs were field complete, with closure awaiting drawing updates. NWP is tracking the backlog of ECOs/ECNs monthly, and the backlog is decreasing. Previous reviews identified problems with lack of limits on time and on the number of allowable outstanding changes against a drawing before initiation of an update. WP 09-11 now states time limits for the categories of essential and support documents, which include most drawings. However, no limits are placed on the number of extant drawing changes, possibly allowing the accumulation of excessive unincorporated changes against some drawings, particularly those in the “general” drawing category. (See **OFI-NWP-2.**)

Engineering Document Control

WIPP has an electronic document management system (EDMS), Documentum, which is used only as a final, archival repository for records. WP 09-11 provides a roadmap to the other repositories where different types of documents are stored:

- Drawings are in the Drawing Registry on a server in Engineering.
- Procedures are in QMIS.
- The mechanical equipment list is in CHAMPS.
- Safety basis documents are in SharePoint.
- ECNs are in the ECO Registry.

Additionally, uncontrolled electronic copies of drawings, ECN packages, and calculations are also available on an Engineering shared drive; all official copies are kept in hardcopy in the Engineering file room.

This summary demonstrates that the document control process at WIPP is dispersed and controlled by several unrelated procedures using multiple software systems. EA found the following discrepancies in document status and revision level between the different repositories:

- A hardcopy of drawing 412-F-003W was listed in the Drawing Registry, but NWP could not locate it on the Engineering shared drive.
- When EA requested ECN package 15490, NWP provided a package that was in “open” status. However, the ECO Registry listed this ECO package as “closed” and completed. NWP later provided the current version of this ECO package.

Discussions with knowledgeable staff indicated that these discrepancies likely resulted from ineffective updating of the various databases with the most current information. All site personnel are allowed to have access to EDMS, but no site personnel are permitted to electronically store any record in EDMS. Instead, all records to be stored in EDMS are shipped from the WIPP site to an office in Carlsbad for entry. NWP’s Comprehensive Engineering Improvement Plan Schedule for 2017 and following years prioritizes funding requests for implementing an EDMS system at the site. A previous finding in this area (Finding 5 discussed in section 5.6) will remain open pending further improvements.

As noted above, uncontrolled electronic copies are available on the shared drive, while official records are kept in the Engineering file room. Administrative personnel provide access to the engineering file room (which is normally locked) during normal working hours, and the Operations group holds a key for access during off-normal hours. Limited access to controlled copies encourages the use of non-controlled copies and presents unnecessary barriers to information that might be needed during an off-normal event. (See

OFI-NWP-4.)

EA has previously documented concerns about the handling of vendor manuals, specifically the availability of the approved manuals in electronic format and in the file room. On examining a limited sample of vendor manuals, EA found that the manuals were both located in the file room and available electronically. A previous review also noted NWP's use of the aperture card system as the official record copy for drawings. NWP has discontinued that system, and official record copies of drawings are now printed on Mylar and maintained in a restricted access area.

Assessments

The internal NWP engineering assessments that EA reviewed were introspective. MA-ENG2016-02, *Engineering Management Self-Assessment Report*, and OSA-ENG-2016-003, *Engineering SMP Effectiveness Review*, discuss many of the CM issues that EA noted during the current assessment. MA-ENG2016-02 states that electronic copies cannot be relied upon to be the most current copy and asserts the need for a reliable data and record management system in a searchable electronic format, including transitioning to Documentum. MA-ENG2016-02 also recommends more focused assessments of discrepancies between the hardcopy records in the Engineering file room and the various electronic copies.

Configuration Management Conclusions

Overall, NWP has made several improvements in CM. However, this EA assessment identified several ongoing issues in the area of document control:

- Over-reliance on hardcopy records and lack of an onsite electronic records system
- A dispersed document control process that is controlled by several unrelated procedures using multiple software systems
- No procedural limitations on the number of outstanding changes against drawings of any category.

5.4 Cognizant System Engineer Program

This section discusses EA's assessment of NWP Engineering's implementation of the CSE program in accordance with DOE Order 420.1C, addressing CSE training and qualification, ownership of system documentation, and system health reporting.

Objective:

A cognizant system engineer program has been implemented in accordance with the requirements of DOE Order 420.1C, to ensure continued operational readiness of identified systems to meet their safety functional requirements and performance criteria.

Criteria:

- *CSEs have been designated, trained, and qualified (for safety class and safety significant systems, at a minimum) in accordance with DOE requirements. CSEs are responsible for compliance of their system with safety basis requirements and facility design criteria. They are an integral part of the design change process, ensuring that all design documents applicable to their system remain consistent. (DOE Order 420.1C)*
- *CSEs are involved in developing and maintaining System Design Descriptions that identify the requirements associated with the facility's safety SSCs, explain the technical bases for the requirements, and describe the features of the system design provided to meet those requirements. (DOE Order 420.1C)*

- *System assessments are performed on a periodic basis examining the operating status of the system and its ability to perform design and safety functions. (DOE Order 420.1C)*

NWP has a robust CSE program, with CSEs assigned to each system regardless of its functional classification. Over 80% (83 out of 101) of systems also have alternate CSEs assigned. WP 09-CN.08, *WIPP Cognizant System Engineer Training Program Plan (Safety Significant Systems)*, covers the requirements for training and qualification of the CSEs for the 18 systems with a functional classification of SS. NWP has assigned alternate CSEs to 16 of the 18 SS systems, and 6 of the alternates are fully qualified, with the other 10 in training status. EA reviewed qualification documentation for 20 CSEs. All documentation was complete, and satisfactorily met the requirements from WP 09-CN.08. The assignment of alternate CSEs demonstrates deliberate succession planning. At the time of the EA visit, some of the SS systems did not have a fully qualified CSE available, due to a combination of family medical leave and staff turnover. The NWP design authority manager was updating the CSE assignment list to address these vacancies in a timely manner.

The NWP engineering organization structure has many of the CSEs reporting to the design authority manager through functional engineering managers. However, the CSEs for systems related to fire protection report to the fire protection manager, who does not report through the design authority manager, but is part of the engineering organization. Additionally, the CSE for CH transuranic (TRU) waste packaging is in the National TRU Programs organization and does not report through the Engineering manager. The recently completed WP08-PT.00, *Packaging Program Document*, satisfactorily incorporates requirements for CSE selection and assignment. EA did not note any current problems as a result of the CSEs being in different organizations.

EA reviewed a sample of the system design descriptions (SDDs), all of which showed evidence of adequate CSE involvement in developing and maintaining SDDs. Formal change control processes, initiated by the CSE or alternate CSE, are used to keep SDDs current. The SDDs also reflect improved identification of requirement bases, compared to the versions EA reviewed in 2015.

NWP's current process for generating system health reports and presenting the results to NWP management is thorough and effective, with one exception noted below. The system health reports reviewed by EA appropriately address system obsolescence, deferred maintenance, and other issues that require management awareness.

The current version of WP 09-CN3025, *System Health Walkdown and Health Reports*, omits the DOE Order 420.1C, Attachment 2, Chapter V, Section 3.c.(3)(b) requirement that the periodic system assessment is to include comparison of the physical configuration to system documentation. **(Deficiency)** A prior revision of WP 09-CN3025 included a checklist in the electronic attachment Section 7, which included items 13a and 13b to identify applicable drawings, note which ones would be reviewed on the walkdown, and comment on the comparison to as-found field conditions. System health walkdowns based on this earlier version continued to identify discrepancies between the physical configuration and the system documentation, highlighting the importance of meeting this DOE Order 420.1C requirement.

NWP has also implemented a periodic inspection of credited design features, using WP 12-NS3017, *In Service Inspection of WIPP Design Features*. The procedure recognizes that design features are normally passive attributes of a facility and are not subject to significant alteration. However, degradation and deterioration may, over time, render the design feature unable to perform its safety function. EA considers the use of periodic in-service inspection to confirm that design features are capable of performing their safety function to be a **Best Practice**.

CSE Program Conclusions

The robust NWP CSE program exceeds requirements, with CSEs assigned to all systems, not just the required SS systems. The in-service inspection of design features is considered a best practice, and NWP's use of alternate CSEs demonstrates deliberate succession planning. The CSE for CH TRU waste packaging does not report through Engineering, but EA noted no current problems resulting from this arrangement. EA identified one issue, in that the current version of WP 09-CN3025 does not require comparison of system physical configuration to system documentation, as required by DOE Order 420.1C.

5.5 Engineering Issues Management

Engineering often has a key role in identifying problems, determining the needed corrective actions, and implementing those actions through the engineering change process. EA performed a limited review of previously-identified issues in this area. Note that WIPP uses the term "WIPP Form" for documents used to identify and correct problems.

Objective:

Programs and processes are in place to identify and correct problems, ensure that personnel are appropriately trained and qualified, and assess internal performance, identifying lessons learned and implementing appropriate corrective actions. (10 CFR 830)

Criteria:

- *An effective contractor assurance process is in place wherein problems are identified and corrective actions are determined and accomplished in a timely manner. Corrective actions are effective in addressing both the extent of condition of the identified problem and recurrence control. (10 CFR 830)*
- *Internal assessments are performed on a periodic basis to examine performance with regard to procedural and programmatic requirements. Assessors are independent of the area being examined. Lessons learned are identified and communicated to engineering personnel. Identified problems are documented using the contractor assurance system and tracked to completion of corrective actions. (10 CFR 830)*

The review scope included a sampling of WIPP Forms identified in previous EA reports and a sampling of new WIPP Forms generated since the EA engineering assessment in 2015. EA found that over the last three years, the number of WIPP Forms generated has more than doubled, indicating improved participation by the facility staff in the problem identification process. Individual WIPP Forms generally exhibit effective corrective action plans, with one exception related to a previous EA finding, identified as Finding 5 in Section 5.6, below.

That finding detailed a concern about the availability of engineering records, as documented in WIPP Form WF15-490 in the WIPP corrective action system. In response to the finding, NWP created a file folder on a shared drive to house electronic copies of ECOs, ETOs, calculations, manuals, and drawings. Although NWP closed WF15-490 upon creation of the shared drive, the documents on the shared drive are still unofficial, uncontrolled copies and are not guaranteed to be the current version. The shared drive is a convenient way for staff to access information, but it does not fully address the EA finding and could lead to problems related to use of uncontrolled information in the design process. EA concluded that WF15-490 was closed based on actions that were inadequate to resolve the issue. **(Deficiency)**

Separately, EA found that the contractor assurance staff now performs effectiveness reviews on a sample of WIPP Form closures, and Operations is now doing fact-finding reviews for significant issues.

Engineering management is pushing completion of corrective actions and has invoked administrative measures to limit schedule extensions; the owner can extend the schedule once, but further extension requires approval from the Engineering manager.

Engineering Issues Management Conclusions

The limited sample of WIPP Forms that EA reviewed reflects improved issues management within Engineering. Corrective action plans reviewed were generally adequate to resolve the documented issues, with a single exception identified. Engineering is making efforts to improve timeliness.

5.6 Follow-up on Previous Findings

The table below discusses relevant findings from previous EA activities at WIPP, along with follow-up observations from the current EA assessment.

Objective:

Corrective action plans must be developed and implemented for independent oversight appraisal findings.

Criterion:

The contractor must prepare, implement, and track to completion corrective actions to address findings identified in EA appraisal reports. Findings and other deficiencies identified in appraisal reports are managed in accordance with established issues management systems (DOE Order 226.1) and quality assurance programs (DOE Order 414.1 and 10 CFR Part 830). (DOE Order 227.1A)

	Report	Finding
1	Enterprise Assessments Review of Waste Isolation Pilot Plant Engineering and Procurement Processes - November 2015 Finding F-NWP-01	The NWP calculation process lacks a tracking and closure process for unverified assumptions, permits calculations based on unverified assumptions to be used in the implemented design basis for the facility, and provides inadequate control and accessibility of calculation records. (10 CFR 830, Subpart A, and DOE-STD-1189-2008) Follow-up Results EA’s review of the calculation procedure (see Section 5.1, above) noted that NWP has made revisions to address these issues. The procedure defines steps for documentation, tracking, and closure of unverified assumptions using the commitment tracking system. The ECN procedure has been revised to require closure verification for calculation open items before returning an SSC affected by the change process to service. The calculation procedure has also been revised to provide an adequate means of numbering calculations. Completed calculations may be filed in the Engineering file room, which maintains the hardcopy as the record copy and makes an electronic copy available, or they may be included in a change package if performed in direct support of that package. These measures are adequately documented in the appropriate WIPP procedures and are sufficient to support resolution of this finding.

	Report	Finding
2	Enterprise Assessments Review of Waste Isolation Pilot Plant Engineering and Procurement Processes - November 2015 Finding F-NWP-02	WP 09-CN3007, <i>Engineering Change Order Preparation and Design Document Change Control</i> , permits changes to the facility without documentation of the technical basis and justification for those changes. (10 CFR 830, Subpart A) Follow-up Results WP 09-CN3007, Revision 46, included changes requiring documentation of the technical basis for the proposed design change. However, those words were removed in Revision 47 and are not included in the current revision (Revision 48). Therefore, NWP has not adequately addressed this finding. This issue is discussed further in Section 5.1, above.
3	Enterprise Assessments Review of Waste Isolation Pilot Plant Engineering and Procurement Processes - November 2015 Finding F-NWP-03	Fire suppression in Building 411 is outside of analyzed hydraulic conditions, and its performance cannot be assured. (10 CFR 830, Subpart B) Follow-up Results EA performed a technical review of the engineering products (see Section 5.2, above) associated with the closure of this finding. Calculation CALC-15-018, Revision 1, <i>Fire Pump Discharge Pressure</i> , analyzes five different flow paths and includes the required valve lineup to establish the analyzed flow paths. The calculation is included with ETO-Z-229, <i>Fire Pump Discharge Required to Operate the Waste Handling Building 5th Floor Sprinkler System</i> . The current TSR document includes surveillance requirement 4.1.1.5 to ensure that one of the analyzed flow paths is in use. These measures are sufficient to support resolution of this finding.
4	Enterprise Assessments Review of Waste Isolation Pilot Plant Engineering and Procurement Processes - November 2015 Finding F-NWP-04	The basis of TSR 4.1.1.7, Pump Output, does not ensure the system's capability to meet DSA requirements. (10 CFR 830, Subpart B) Follow-up Results The current TSR document includes new surveillance requirements with new set points that are appropriately documented in ETO-Z-230, <i>LCO 3.1.1.1 Set Point Determination Calculation</i> . EA performed a technical review of this ETO (see Section 5.2, above). These measures are sufficient to support resolution of this finding.

	Report	Finding
5	Enterprise Assessments Review of Waste Isolation Pilot Plant Engineering and Procurement Processes - November 2015 Finding F-NWP-05	The document control and records handling processes do not adequately control the creation and maintenance of records and do not provide sufficient accessibility to support facility operations. (10 CFR 830, Subpart A) Follow-up Results This issue is discussed in detail in Section 5.3, above. Access to most engineering records has improved through the use of uncontrolled electronic copies available from a local server; however, controlled copies remain reliant on hardcopy records with limited access, and other electronic records are dispersed over at least five different retrieval systems. Therefore, NWP has not adequately addressed this finding.
6	Observations of the Design and Modification Progress of WIPP Underground Interim Ventilation System and Supplemental Ventilation System - November 2015 FINDING-WIPP-02	Contrary to the requirements of DOE Order 414.1D, Attachment 4, NWP has not validated and verified the airflow modeling software used for design analysis. Follow-up Results NWP performed a quality assurance audit of the SRK/MVS quality assurance program, including software verification and validation. NWP Audit Report E17-03, issued on February 7, 2017, documented audit details. AR/VR-17, dated July 17, 2017, documented NWP's conclusion that the MVS software qualification "Software Verification and Validation for VnetPC Pro+," dated February 22, 2017, was satisfactorily performed and approved. These measures are adequately documented and are sufficient to support resolution of this finding.

Findings Follow-up Conclusions

Four of the six findings listed have been adequately addressed, and EA considers them to be resolved. Further efforts on the part of NWP will be necessary to support resolution of the remaining findings.

5.7 Federal Oversight Program

EA examined the activities and functions of the CBFO Facility Engineering Division, with a focus on effectiveness of that group in monitoring and oversight of NWP Engineering.

Objective:

Federal oversight programs are established and effective in ensuring that safety systems can reliably perform as intended.

Criterion:

The DOE site office has established and implemented an effective safety system oversight program for qualifying staff to apply engineering expertise in its oversight of the assigned safety systems and to monitor performance of the contractor's CSE program. (DOE Order 426.1A, Appendix C)

For this portion of the assessment, EA reviewed the safety system oversight (SSO) engineer qualification process, oversight planning documents, and two surveillance reports generated from oversight activities, and also interviewed several SSO engineers.

The qualification process is appropriately modeled on requirements from DOE Order 426.1A, *Federal Technical Capability Program, Appendix C, Safety System Oversight, Duties, Responsibilities, Knowledge, Skills, and Abilities*. One SSO engineer is fully qualified at this time, and the other three are working toward that goal.

The CBFO *Contractor Oversight Plan* (DOE/CBFO-04-3299), the *Integrated Evaluation Plan*, and the *Safety System Oversight Program Plan* (DOE/CBFO-09-3439) are well-aligned with the SSO duties and responsibilities established in DOE Order 426.1A. The *Integrated Evaluation Plan*, in particular, lays out an aggressive oversight schedule for the remainder of 2017.

EA reviewed two surveillance reports, one related to fire protection and the other a draft report on SVS startup testing. Both reports had a well-defined scope and were adequately critical in verifying compliance/non-compliance with DOE requirements.

EA interviewed three of the four CBFO SSO engineers. All three were knowledgeable of their assigned systems, and well-versed in DOE oversight requirements. The SSO engineers are active in performing field walkdowns of their respective scopes. Any problems noted are documented for resolution by NWP. Feedback from the SSOs indicated that their NWP counterparts are conscientious about documenting problems on WIPP Forms, and corrective action plans are generally appropriate. All of the SSO engineers track corrective actions pertinent to their systems.

Federal Oversight Conclusions

The CBFO Facility Engineering Division oversight process is well structured and defined. Individual SSO engineers are knowledgeable and active in performing oversight in their assigned areas.

6.0 FINDINGS

EA identified no findings during this assessment. Deficiencies that did not meet the criteria for a finding are listed in Appendix C of this report, with the expectation from DOE Order 227.1A for site managers to apply their local issues management processes for resolution.

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.

7.0 OPPORTUNITIES FOR IMPROVEMENT

EA identified some OFIs 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 these OFIs only as recommendations for line management consideration; they do not require formal resolution by

management through a corrective action process and are not intended to be prescriptive or mandatory. Rather, they are suggestions that may assist site management in implementing best practices or provide potential solutions to issues identified during the assessment.

Nuclear Waste Partnership, LLC:

- OFI-NWP-1** Consider revising WP 09-CN3018, *Design Verification*, to clarify its applicability to calculations, particularly when those calculations are embedded in change packages.
- OFI-NWP-2** Consider placing a formal limit on the number of outstanding changes against drawings of any category to drive updates and enhance design control.
- OFI-NWP-3** Consider revising WP-09-CN3031, *Engineering Calculations*, and other engineering procedures that provide guidance for preparation of engineering deliverables to point to and consider the ETO procedure operability evaluation process when required.
- OFI-NWP-4** In the absence of an onsite electronic document management system, consider additional measures to improve access to controlled copies of engineering records. Additional rigor in the internal process for placing electronic copies of engineering documents on the local server might address the inconsistencies noted and support establishment of these copies as controlled records.

Appendix A Supplemental Information

Dates of Assessment

Onsite Assessment: July 10 – August 3, 2017

Office of Enterprise Assessments (EA) Management

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

Quality Review Board

Steven C. Simonson
Thomas R. Staker
William E. Miller
Michael A. Kilpatrick

EA Site Lead for WIPP

Alem Boatright

EA Assessors

Charles Allen – Lead
Samina Shaikh
Greg Teese
Joseph Panchison

Appendix B

Key Documents Reviewed, Interviews, and Observations

Documents Reviewed

AR/VR 3-10-1, CALC 15008-005, *Underground Fan Skid Design*, Revision 1, 6/29/2015
AR/VR 04, *SRK Consulting Memorandum*, 6/8/2017
AR/VR 5, CALC 15008-004, *Supplemental Ventilation System (SVS) Fan Speed Analysis*, Revision A, 5/6/2015
AR/VR 21-1, *SVS Software Change Log*, 6/8/2017
AR/VR 23-1, CALC 15008-001, *NWP Underground Fan Pressure Loss*, Revision 1, 6/8/2015
AR/VR 25, *Supplemental Ventilation System (SVS) Control Strategy*, Revision B, 5/6/2015
AR/VR 35, CALC 15008-002, *Instrument Accuracy, Differential Pressure Transmitters*, Revision 1, 6/8/2015
AR/VR 36, CALC 15008-003, *Cabinet Temperature, Main Control Panel*, Revision 1, 6/8/2015
CA-2017-IVR-001, *Supplemental Ventilation System Implementation Verification Review Assessment Plan*, 6/13/2017
CA-IA-2017-001, *Supplemental Ventilation System Implementation Verification Review Assessment Report*, 6/21/2017
CALC-15-004, *Fire Pump Discharge Pressure Required to Operate WHB 5th Floor Sprinkler System*, Revision 0, 9/16/2015
CALC-15-018, *Fire Pump Discharge Pressure Required to Operate WHB 5th Floor Sprinkler System*, Revision 0, 11/16/2015
CALC-15-018, *Fire Pump Discharge Pressure*, Revision 1, 2/9/2016
CALC 15-021, *WHB Operability Setpoints*, Revision 0, 11/18/2015
CALC 15-021, *WHB Operability Setpoints*, Revision 1, 3/4/2016
CALC 15-021, *WHB Operability Setpoints*, Revision 2, 4/6/2016
CALC-16-008, *Uncertainty of Mechanical Gauges for Differential Pressure Measurement Across HEPA Filter Banks*, Revision 0, 2/18/2016
CALC-16-011, *Tensile Strength Needed for Bolts on TRUPACT Lid Stands*, 2/19/2016
CALC-16-015, *Force & Velocity of Load CH Crane Colliding with Lid Stand*, 4/1/2016
COG-ENG-01, *Cognizant System Engineer Qualification Card*, Revision 3, 11/8/2016
COG-ENG-01, *Cognizant System Engineer Qualification Card*, Revision 2, 9/14/2016
Comprehensive Engineering Improvement Plan Schedule for CY 2017, 7/10/2017
DCN 1100, *System Updates Resultant from SHR Walkdown*, 6/29/17
DCN 1013, *ED02, 03, 04, 08, 09, & 15 Drawing and Component Changes*, 12/28/2016
DCN 1098, *Revise May 2017 SHR Completed on Incorrect Form Version to the Current Version Without Changing Content*, 6/14/2017
DOE/WIPP-06-3335, *Waste Isolation Pilot Plant Nuclear Maintenance Management Plan*, Revision 4, 4/7/2016
DOE/WIPP 07-3372, *Waste Isolation Pilot Plant Documented Safety Analysis*, Revision 5b, 4/2016
DOE/WIPP 07-3373, *Waste Isolation Pilot Plant Technical Safety Requirements*, Revision 5b, 4/2016
DWG-15008-M101, *WIPP Underground Fan-WIPP Underground Skid Assembly*, Revision 2, 9/9/2015
DWG-15008-M-102, *WIPP Underground Fan-Lower Skid Assembly*, Revision 2, 9/9/2015
DWG-15008-M 103, *WIPP Underground Fan-Fan Assembly Skid*, Revision 3, 9/9/2015
DWG-15008-M-104, *WIPP Underground Fan-Inlet Silencer Skid*, Revision 3, 9/9/2015
DWG-15008-M-110, *WIPP Underground Fan-Lower Skid Rail 4*, Revision 4, 9/9/2015
DWG-15008-M-111, *WIPP Underground Fan-Miscellaneous Parts and Details*, Revision 1, 9/9/2015
EA12ER.25-1-0, *Underground Escape and Evacuation Map*, Revision 2, 5/8/2017
ECN 14097, *Revise Underground Ventilation Flow System Drawing 54-A-160-W11*, 2/1/2017
ECN 14103, *Install New Bumper on TRUDOCKs for Spacing Concern*, 5/22/2017

ECN 14123, *Crib Installation on South End of Mine*, 5/15/2017
 ECN 14109, *Disconnect Actuators and Blank Off Louvers and Duct Penetration for 74-B-707*, 3/24/2017
 ECO 13888, *Drawing and Component Update for ED17, Rev 3*, October 26, 2015
 ECO 13890, *Installation Of Outdoor Enclosures For Filter Change On 41-B-956 And 41-B-957 Filter Units*, 5/12/16 (including addendums 1 & 2)
 ECO 13891, *Installation Of Additional HEPA Filter Differential Pressure Instrumentation*, 3/7/16 (including addendums 1 & 2)
 ECO 13891, *Addendum 1*, 3/22/2016
 ECO 13891, *Addendum 2*, 5/10/2016
 ECO 13897, *Revise SDD ED00*, 2/9/16
 ECO 13904, *Fabricate and Install New Bulkhead for UG Lube Oil Storage Area at E420/S80*, 4/28/2016
 ECO 13904, *Addendum 1*, 7/22/2016
 ECO 13904, *Addendum 2*, 7/27/2017
 ECO 13904, *Addendum 3*, 8/5/2016
 ECO 13914, *Adding Gages to CH HEPA filter 41-B-814, 815, 834, and 979*, 3/7/16
 ECO 13915, *Install Door Closer on UFE Office Bulkhead 74-B-219 Man Door and Update MLD*, 4/11/2016
 ECO 13916, *Install Door Closer on Maintenance Shop Bulkhead 74-B-520 Man Door and Update MLD*, 4/11/2016
 ECO 13919, *Add Anchor Bolt Requirements To TRUPACT Lid Stand Drawings*, 3/2/16
 ECO 13919, *Addendum 1*, 5/6/2016
 ECO 13923, *Installing SS Pressure Transmitter at Bulkhead 308*, 3/5/16
 ECO 13933, *Correct Drawing Found On System Walkdown For PC03*, 4/13/16
 ECO 13935, *Mini Excavator*, 6/14/2016
 ECO 13935, *Addendum 1*, 9/29/2016
 ECO 13935, *Addendum 2*, 9/29/2016
 ECO 13939, *Revision V of 51-W-215-W add U/G Facility Locations*, 4/12/2016
 ECO 13942, *Provide Fire Detection In The High-Efficiency Particulate Air (HEPA) Filter Enclosure Of The Interim Ventilation System (IVS)*, 6/9/2016 (including addendums 1, 2 & 3)
 ECO 13972, *Establish a Low-Low Flow Alarm in the CMS for Station C*, 7/6/16
 ECO 13981, *Modify SDD VU00 To Incorporate Additional Information On The 309 dP Instrumentation*, 5/31/16
 ECN 13983, *Replacement of Injection and Sampling Manifolds for Testing of HEPA Filter Banks in 41-B-856 and 41-B-857*, 2/14/17
 ECO 13990, *Establish an Equipment Number for the Station "A" Probe Pull Adapter*, 6/20/16
 ECO 14038, *General Plant Design Description*, 9/6/16
 ECO 14047, *Changes to Specification for Prepackaged MgO Backfill, D-0101*, 1/6/17
 ECO 14054, *Update/Revise the System Design Description (SDD) for UH00*, 9/19/2016
 EN: 16:00050, UFC:6500.00, *Interoffice Correspondence-Engineering Immediate Corrective Actions in Response to TSR Violation on June 6, 2016*, 6/9/2016
 ETO-I-259, *Review of Anchoring for TRUDOCKs, Stairs, and TRUPACT Lid Stands*, Revision 0, 2/19/2016
 ETO-I-259, *Review of Anchoring for TRUDOCKs, Stairs, and TRUPACT Lid Stands*, Revision 1, 4/1/2016
 ETO-K-311, *The Operability of Underground Ventilation Filtration System in Alarm Conditions*, Revision 0, 6/28/2016
 ETO-U-335, *Preventive Maintenance for the CAT 304E2 CR Mini Excavator*, Revision 0, 1/20/2017
 ETO-Z-209, *Operability of the WHB 5th Floor Sprinkler System*, Revision 0, 10/19/2015
 ETO-Z-229, *Fire Pump Discharge Pressure Required to Operate WHB 5th Floor Sprinkler System*, Revision 0, 11/18/2015

ETO-Z-229, *Fire Pump Discharge Required to Operate WHB 5th Floor Sprinkler System*, Revision 1, 2/9/2016
 ETO-Z-229, *Fire Pump Discharge Required to Operate WHB 5th Floor Sprinkler System*, Revision 2, 7/22/2016
 ETO-Z-229, *Fire Pump Discharge Required to Operate WHB 5th Floor Sprinkler System*, Revision 3, 8/16/2016
 ETO-Z-230, *LCO 3.1.1 Set Point Determination Calculation*, Revision 0, 11/18/2015
 ETO-Z-230, *LCO 3.1.1 Set Point Determination Calculation*, Revision 1, 3/4/2016
 ETO-Z-230, *LCO 3.1.1 Set Point Determination Calculation*, Revision 2, 4/6/2016
 ETO-Z-265, *Evaluate Use of Standard Door Closure Mechanism for Underground Bulkhead Man Doors*, Revision 0, 3/16/2016
 HV01 Annual System Health Report, 05/31/2016
 HV01 Annual System Health Report, 06/13/2017
 INF-866, *WP 09-CN3025, Revision 20 System Health Walkdown and Health Report General Procedure Change Briefing*
 MA-ENG-2016-02, *GAP Analysis of WIPP Engineering Program*, Revision 1, 08/01/2016
 MSA-ENG-2017-001, *Evaluation of Implementing Engineering Procedure WP 09-CN3025, Rev. 20, System Health Walkdown and System Health Report*, 5/9/2017
 MSA-ENG-2017-002, *VU01 System Health Report*, 11/29/2016
 MSA-ENG-2017-003, *PP01 System Health Report*, 12/12/2016
 MSA-ENG-2017-004, *ED02 System Health Report*, 1/5/2017
 MSA-ENG-2017-005, *ED03 System Health Report*, 2/22/2017
 MSA-ENG-2017-006, *ED04 System Health Report*, 2/22/2017
 MSA-ENG-2017-007, *ED08 System Health Report*, 2/22/2017
 MSA-ENG-2017-008, *ED09 System Health Report*, 2/22/2017
 MSA-ENG-2017-009, *ED15 System Health Report*, 2/22/2017
 NWP Work Order 1733771, *Functional Testing of SVS 74-B-110D and Associated Components*, 5/16/2017
 OSA-ENG-2016-003, *Waste Isolation Pilot Plant Engineering SMP Effectiveness Review*, 3/31/2016
 OSA-ENG-2016-004, *System Health Reports*, 3/31/2016
 SDD AU00, *Underground Facilities and Equipment (AU00) System Design Description (SDD)*, Revision 10, 10/19/2016
 SDD FP00, *Fire Protection System (FP00) System Design Description (SDD)*, Revision 22, 9/27/2016
 SDD UH00, *Underground Hoisting System (UH00) System Design Description (SDD)*, Revision 13, 1/18/2017
 SDD VU00, *Underground Ventilation System Design Description (SDD)*, Revision 25, 3/29/2017
 SRK Consulting, *2016 IVS Test and Balance Report*, 10/26/2016
 System Health Report, HV01, *CH Area HVAC System*, 6/19/17
 System Health Report, VU01, *Exhaust Fans and Filters*, 11/30/16
 System Health Report, PP01, *Perimeter Fencing and Gates*, 11/29/16
 System Health Report, ED02, *13.8kV Switchgear and Equipment*, 12/19/16
 System Health Report, ED03, *4.16 & 2.4 kV Switchgear and Equipment*, 12/19/16
 System Health Report, ED04, *480V Switchgear and Equipment*, 12/20/16
 System Health Report, ED08, *Central Uninterruptible Power Supply*, 12/21/16
 System Health Report, ED09, *Backup Diesel Generators*, 12/20/16
 System Health Report, ED15, *Grounding and Lightning Protection*, 12/20/16
 System Health Report, WH02, *Contact Waste Handling Equipment*, 12/7/16
Waste Isolation Pilot Plant Training Implementation Matrix, Revision 10, 9/30/2015
 WF17-418, *CAP - Cause Analysis Report*, Revision 0, 6/5/2017
 WF17-649, *CAP - Cause Analysis Report*, Revision 0, 7/3/2017

WIPP Cognizant System Engineer/Alternate Cognizant System Engineer System Assignment List,
 Revision 60, May 8, 2017
 WO 1616010, *FP01 Ann System Walkdown - VSS*, 2/5/2016
 WO 1617294, *HV01 Ann System Walkdown - VSS*, 6/6/2016
 WO 1739432, *AU03 - Perform Visual Inspection of U/G Fuel and Oil Storage in Accordance with Design Feature Key Elements*, 6/9/2017
 WP EA09CN3025-1-0, *System Health Report*, Revision 8, 11/10/2016
 WP 04-AD.22, *Mine Ground Control Guide*, Revision 1, 5/31/17
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 WP 09-CN3003, *As-Built Drawings: Process and Control*, Revision 16, 2/08/17
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Interviews

NWP

- Engineering Manager
- Engineering Deputy Manager
- Engineering Programs Manager
- Nuclear Safety Program Manager
- Nuclear Safety Manager
- Fire Protection Engineering Manager
- Project Engineering Manager
- Design Engineering Manager
- Design Authority Manager
- Design Authority Manager – Permanent Ventilation System
- Design Authority Senior Technical Advisor
- Packaging Implementation and Technical Support Manager
- Packaging Implementation and Technical Support Team Lead
- Nuclear Safety Program Manager
- Facility/Ventilation Systems Manager
- Fire Protection Manager
- Geotechnical & Mine Engineering Manager
- Cognizant System Engineers (5)
- Underground Facility Engineer

CBFO

- Director - Facility Engineering Division
- Safety System Oversight Engineers (4)
- Facility Representatives (3)

Observations

- Walkdown of Doors for Rooms in the Underground with Agent-Based Fire Suppression
- Walkdown of Flammable Lubricating Oil Storage Area in the Underground
- Shaft Inspection of the Air Intake Shaft
- Partial System Walkdown for AU03 Underground Shaft Pillar Facilities
- Walkdown of Ventilation Overcast at N-150, E-0 for SVS

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.

- Contrary to 10 CFR 830.122, WP 09-CN3007, *Engineering Change Notice*, permits changes to the facility without documentation of the technical basis and justification for those changes.
- Contrary to 10 CFR 830.122, calculations are not issued as standalone documents, resulting in loss of design control when multiple overlapping calculations are issued to support multiple design change packages for the same components.
- Contrary to 10 CFR 830.122 and WP 09-CN3031, *Engineering Calculations*, requirements for design verification have not been adequately implemented in calculations embedded in engineering change packages.
- Contrary to 10 CFR 830 and NQA-1-1989, multiple calculations and technical document submittals from subcontractors, intended to support and provide the basis for credited safety controls, are not in compliance with requirements for calculations and technical document content.
- NWP's process for checking and approving calculations did not determine the engineering approach to be sound and technically rigorous, as required by WP 09-CN3031.
- NWP's process for checking and approving evaluations of technical operability did not identify incorrect, unverified assumptions that rendered the engineering approach unsound, contrary to requirements of WP 09-12, *Evaluation of Technical Operability Adequacy of Facility Systems, Structures, and Components*.
- NWP does not require periodic system assessments to compare physical configuration of systems to system documentation as required by DOE Order 420.1C, Attachment 2, Chapter V, Section 3.c.(3)(b).
- Measures taken to resolve a previous finding on availability of controlled copies of engineering records did not adequately resolve the concern identified. (DOE STD-1073-2003)