



Independent Assessment of Construction Safety for the Utility Shaft Project at the Waste Isolation Pilot Plant

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Office of Enterprise Assessments
U.S. Department of Energy

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Acronyms

CFR	Code of Federal Regulations
DOE	U.S. Department of Energy
EA	Office of Enterprise Assessments
EMP	Explosives Management Plan
HWSS	Harrison Western-Shaft Sinkers Joint Venture
MSHA	Mine Safety and Health Administration
NWP	Nuclear Waste Partnership, LLC
OFI	Opportunity for Improvement
OSHA	Occupational Safety and Health Administration
PSTR	Project Subcontract Technical Representative
WIPP	Waste Isolation Pilot Plant
WP	Work Procedure

INDEPENDENT ASSESSMENT OF CONSTRUCTION SAFETY FOR THE UTILITY SHAFT PROJECT AT THE WASTE ISOLATION PILOT PLANT

Executive Summary

The U.S. Department of Energy Office of Enterprise Assessments (EA) conducted an independent assessment of construction safety for the Utility Shaft Project at the Waste Isolation Pilot Plant on March 14-17, 2022. This assessment evaluated the subcontracted construction activities of Harrison Western-Shaft Sinkers Joint Venture (HWSS), a subcontractor to the management and operating contractor Nuclear Waste Partnership, LLC (NWP). Additionally, this assessment evaluated oversight of the Utility Shaft Project by NWP.

EA identified the following strength:

- NWP and HWSS have effectively flowed down safety requirements to lower-tier subcontractors working on the project.

EA also identified the following weaknesses:

- Several workers were below an elevated work activity that potentially placed them at risk from dropped objects. The area was not barricaded or marked with access control lines.
- HWSS did not conduct the requisite analyses to demonstrate that previous blasting and mining activities were below the American Conference of Governmental Industrial Hygienists threshold limit value for silica. Without analysis of potential crystalline silica hazards, worker exposures may not be properly controlled.
- HWSS did not ensure that the explosives safety program fully complies or performs to requirements. Specific shortcomings included forklift fire protection controls, magazine doors left in the open position, lack of explosives training records, and a lack of restrictions on running vehicles next to the magazines.
- NWP closed explosive inventory related issues identified in a management self-assessment without a resolution.

In summary, NWP and HWSS have developed and implemented a generally adequate construction safety program for the Utility Shaft Project. However, until the concerns identified in this report are addressed or effective mitigations are put in place, workplace hazards may not be identified and addressed to sufficiently protect worker safety and health.

INDEPENDENT ASSESSMENT OF CONSTRUCTION SAFETY FOR THE UTILITY SHAFT PROJECT AT THE WASTE ISOLATION PILOT PLANT

1.0 INTRODUCTION

The U.S. Department of Energy (DOE) Office of Worker Safety and Health Assessments, within the independent Office of Enterprise Assessments (EA), assessed the safety of construction work performed for the Utility Shaft Project at the Waste Isolation Pilot Plant (WIPP). This assessment was requested by the DOE Carlsbad Field Office. Assessment planning and document collection began in January 2022, and the onsite assessment was conducted on March 14-17, 2022.

Nuclear Waste Partnership, LLC (NWP) is the management and operating contractor for WIPP. NWP manages the Utility Shaft Project, with the physical construction work primarily conducted under a subcontract with Harrison Western-Shaft Sinkers Joint Venture (HWSS). Consistent with the *Plan for the Construction Safety Assessment at the Waste Isolation Pilot Plant Utility Shaft Project, February 2022*, this assessment evaluated NWP's implementation of DOE requirements to control construction, mining, and explosives hazards associated with Utility Shaft Project work activities. During the onsite portion of this assessment, EA observed construction work performed by HWSS and three HWSS subcontractors. EA also reviewed NWP oversight of the Utility Shaft Project construction work activities.

The Utility Shaft Project includes the installation of a new shaft, Number 5, a 2,275-foot-deep vertical shaft with a finished diameter of 26 feet, which will provide an additional air intake source for the WIPP underground. At the time of the assessment, the shaft was already pre-sunk to a depth of approximately 115 feet and the shaft headframe (structural frame above the mine shaft to enable the hoisting of machinery, personnel, or materials) was in the process of being installed. No mine shaft or explosives work was in progress, and no explosive materials were present while EA was on site.

2.0 METHODOLOGY

The DOE independent oversight program is described in and governed by DOE Order 227.1A, *Independent Oversight Program*, which is implemented through a comprehensive set of internal protocols, operating practices, assessment guides, and process guides. This report uses the terms "best practices, deficiencies, findings, and opportunities for improvement (OFIs)" as defined in the order.

As identified in the assessment plan, this assessment considered requirements related to construction, mine, and explosives safety. EA used the sections of criteria and review approach document (CRAD) EA-32-10, Rev. 0, *Construction Safety*. Additionally, criteria from DOE Guide 226.1-2A, *Federal Line Management Oversight of Department of Energy Nuclear Facilities, Appendix D: Activity-Level Work Planning and Control Criterion Review and Approach Documents with Lines of Inquiry*, were used to assess the development of activity-level work control documents regarding the five core functions of integrated safety management. EA also used selected objectives and criteria from CRAD EA 32-03, Rev. 1, *Industrial Hygiene*, and CRAD 32-01, Rev. 1, *Explosives Safety*.

EA examined key documents, such as system descriptions, procedures, manuals, job hazard analyses, safe work plans, policies, and training and qualification records. EA also interviewed key personnel responsible for developing and executing the associated programs; observed hoisting and rigging,

material handling, and welding activities; and walked down significant portions of the shaft headframe, focusing on construction, mine, and explosives safety. The members of the assessment team, the Quality Review Board, and the management responsible for this assessment are listed in appendix A.

There were no previous findings for follow-up addressed during this assessment.

3.0 RESULTS

3.1 Construction Safety Requirements Flowdown

This portion of the assessment evaluated NWP flow down of DOE construction, mine, and explosives safety requirements to HWSS and lower-tier contractors, and established oversight mechanisms.

NWP effectively flows down DOE construction, mine, and explosives safety requirements, as well as 10 Code of Federal Regulations (CFR) 851, *Worker Safety and Health Program*, to HWSS in contract DOE13-PO511747 and Statement of Work 18-019, *Utility Shaft - Shaft Number 5 and Drift Construction*. In addition, NWP appropriately incorporates contractual requirements for HWSS to follow WIPP work procedures (WPs) that implement DOE requirements, including: (1) WP 15-GM.02, *Worker Safety and Health Program Description*; (2) WP 15-GM.03, *Integrated Safety Management System Description*; and (3) WP 12-IS.01-6, *Industrial Safety Program - Visitor, Vendor, User Tenant, and Subcontractor Safety Controls*.

Three reviewed subcontracts issued by HWSS (for hoisting and rigging, welding, and electrical services) demonstrated that construction safety requirements were adequately flowed down to lower-tier contractors. Reviewed documents also demonstrated that HWSS effectively integrated lower-tier subcontractor work activities into its work planning documentation, such as daily safe work plans, job hazard analyses, permits, and lift plans. This approach ensures that NWP requirements are addressed for all performed work.

In addition, NWP has established appropriate oversight mechanisms for ensuring that its subcontractors implement construction, mine, and explosives safety requirements. These mechanisms include day-to-day oversight of construction work by project subcontractor technical representatives (PSTR), frequent walkthroughs by project managers and safety professionals, and review and approval of safety-related documentation (e.g., training records, hazard analyses, and lift plans). On a periodic basis, NWP analyzes Utility Shaft Project safety performance metrics and uses contract management tools, such as contract stop-work actions in response to HWSS safety performance issues.

Construction Safety Requirements Flowdown Conclusions

The DOE contract with NWP includes appropriate construction, mine, and explosives safety requirements, which flow down to HWSS. HWSS effectively flows DOE and NWP requirements to lower-tier subcontractors. NWP also implements robust oversight mechanisms for ensuring that its lower-tier subcontractors implement construction, mine, and explosives safety requirements.

3.2 Construction Safety Requirements Implementation

This portion of the assessment evaluated whether HWSS and lower-tier subcontractors met safety requirements in the performance of observed construction work.

Fall Protection (29 CFR 1926 Subpart M and Subpart R)

Three elevated work activities observed by EA were generally conducted in compliance with 29 CFR 1926 subpart M, *Fall Protection*, and 29 CFR 1926 subpart R, *Steel Erection*. Workers used fall protection equipment that was properly inspected, donned, and secured to authorized attachment points while performing work from mobile boom lifts. Overall, fall protection equipment was appropriately stored and accessible to workers. However, an observed open fall protection equipment storage box positioned below an elevated welding operation presented a noticeable fire hazard and risk of damage to its contents from falling welding slag; workers corrected the issue when it was identified by EA and the NWP PSTR on a walk-through and brought to HWSS's attention.

Hoisting and Rigging (29 CFR 1926.251 & Subpart CC)

Observed hoisting and rigging activities were conducted in compliance with the rigger training and equipment inspections and labeling requirements of 29 CFR 1926.251 and subpart CC, *Cranes and Derricks in Construction*. Training records confirmed that observed hoisting and rigging activities were appropriately performed by level 2 certified riggers. Level 2 riggers properly inspected rigging prior to use, made crane connections to the load, and gave direction to the crane operator. Reviewed lift plans supporting the hoisting and rigging activities for critical lifts met Occupational Safety and Health Administration (OSHA) requirements. The lift plans were developed by experienced HWSS personnel with operator input and were approved by the NWP Hoisting and Rigging Committee.

All observed lifting devices, including slings and shackles, were clearly labeled with maximum lifting capacities per OSHA requirements. All observed slings and shackles in use were marked with the correct inspection tape as required by NWP procedure WP 12-IS.01-12, *Hoisting and Rigging*. However, on one occasion, EA observed the comingled storage of inspected lifting slings and shackles with uninspected lifting slings and shackles. This practice increases the risk of using uninspected slings or shackles in a lift. NWP and HWSS initiated timely actions to relocate the storage of inspected lifting slings and shackles to a dedicated area to ensure proper use.

In addition, hoisting and rigging activities did not always follow subpart CC requirements. Contrary to 29 CFR 1926.1424(a)(2)(ii) and 1926.1425(b) and (d), required barrier or control lines were not in place to prevent workers from entering a drop hazard area below an observed overhead welding activity. (See **Deficiency D-HWSS-1**.) Dropped objects can strike and injure workers in the area below elevated work activities. Several workers not actively engaged in a work activity were observed in the area potentially at risk from dropped objects and welding slag. The following day, EA observed that HWSS established barrier tape lines on the ground around the areas of the headframe where overhead work was being conducted. In addition, barrier tape lines were reestablished around crane operations where a previous windstorm had damaged or blown them down.

Respirable Crystalline Silica (10 CFR 851.21 (a)(1))

HWSS's identification of potential respirable crystalline silica hazards is inadequate. The National Institute for Occupational Safety and Health identifies mining activities as a job at risk for exposure to crystalline silica dust. Interviews confirmed that in September 2020, HWSS conducted blasting and mining activities. However, contrary to 10 CFR 851.21 (a)(1), HWSS could not demonstrate that previous blasting and mining activities were properly monitored for silica and that respirable levels of crystalline silica dust were below the American Conference of Governmental Industrial Hygienists threshold limit value. (See **Deficiency D-HWSS-2**.) Without analysis of potential crystalline silica hazards, worker exposures may not be properly controlled. In response to this identified issue, the HWSS

Senior Safety Manager described HWSS's ongoing efforts to establish a silica control plan prior to the resumption of blasting and mining activities.

Construction Safety Requirements Implementation Conclusions

HWSS's construction safety program is generally effective, and construction workers perform work activities in a safe and compliant manner with few exceptions. However, one uncontrolled area beneath an elevated welding activity was identified and HWSS has not analyzed potential crystalline silica hazards.

3.3 Mine Safety

This portion of the assessment evaluated whether HWSS has established a mine safety plan in accordance with the OSHA and Mine Safety and Health Administration (MSHA) requirements and whether NWP conducts effective mine safety oversight.

HWSS has established an adequate mine safety plan (ARVR-010.00-01, *Shaft Ventilation Plan* and *Shaft Construction Work Plan*) that addresses OSHA and MSHA ventilation requirements. This plan is applicable to HWSS and its sub-tier contractors. ARVR-010.00-01 adequately addresses underground ventilation, air quality and quantity, the structural integrity of the shaft walls, and safety inspections. For example:

- Installed, flexible fire-resistant duct will ventilate the shaft working area with fresh air.
- After each blast, blast effluent will be properly exhausted to the surface through the ventilation duct.
- Prior to re-entry after a blast, air quality will be appropriately monitored by qualified personnel for carbon monoxide and nitrous oxides, after a blast clear time of a minimum of 30 minutes; the individuals will also inspect the integrity of the shaft.
- The shaft walls will be supported as the shaft increases in depth, providing adequate protection from falling debris.
- Project engineers will conduct daily checks of the shaft and identify any hazards that may exist for correction, including shaft wall integrity, to prevent falling debris hazards.
- A competent person will monitor gas concentrations associated with underground work activities.

HWSS project managers, superintendents, and engineers are well qualified and experienced to implement this plan as evidenced by the training records for the two project superintendents and three engineers, as well as their demonstrated knowledge of mining practices and safety (in particular, shaft sinking). During interviews, each of the three engineers described having experience with at least 12 different shaft sinking projects, and the construction superintendents described having experience with 14 different shaft sinking projects. Also, the project superintendents and engineers demonstrated adequate knowledge of ARVR-010.00-01 requirements, including underground ventilation and gas monitoring methodologies.

Oversight of HWSS mining activities is appropriately accomplished by NWP. The interviewed NWP Environment, Safety, and Health Field Operations manager described the current practice of overseeing the HWSS work using field safety and industrial hygiene representatives, who are at the shaft work site every day to monitor the working conditions. Field safety representatives were observed performing daily oversight of construction activities at the shaft site and facilitating the morning safety meetings. These field safety representative oversight activities were effective in finding and facilitating corrective actions. In addition, the NWP project subcontract technical representative (PSTR) provided day-to-day onsite oversight of the project activities, including safety. For example, an HWSS 2022 *Daily Log of*

Construction completed for March 14, 2022, included an issue previously identified by an NWP PSTR (i.e., six incorrect fasteners for dump chute connections) and documented actions taken to address the issue. Based on interviews with the PSTR and a review of the NWP-completed qualification card record (Authorization Card # PSTR-01), the PSTR is well qualified to provide oversight of the project hazard controls.

In addition to NWP oversight, the Carlsbad Field Office has appropriately established a memorandum of understanding between DOE and MSHA to provide independent oversight of WIPP underground activities. In March 2022, MSHA conducted a required quarterly inspection and issued a “non-significant and substantial” citation concerning the shaft sinking site. This citation, under 30 CFR 57.12002, was for an opening in an electrical box. The citation record demonstrated that HWSS immediately corrected the citation by sealing the opening in the electrical box; MSHA subsequently closed the citation as abated.

Mine Safety Conclusions

HWSS has established an adequate mine safety plan that addresses underground ventilation, air quality and quantity, the structural integrity of the shaft walls, and safety inspections. HWSS project managers are well qualified and experienced in implementing this plan. Oversight of HWSS mining activities is appropriately accomplished by NWP. As arranged by the Carlsbad Field Office, MSHA provides separate independent inspections.

3.4 Explosives Safety

This portion of the assessment evaluated whether HWSS identifies and controls explosives safety hazards associated with construction activities, including the transportation, storage, handling, and use of explosives.

Transportation

HWSS’s ARVR-511747-005.00-03, *Explosives Management Plan* [EMP], adequately addresses the transportation requirements of DOE-STD-1212-2019, *Explosives Safety*, as invoked through WP 12-IS.01-6. The EMP requires commercial drivers to be registered per 49 CFR 107, subpart G, and trained in accordance with Department of Transportation regulations, regardless of the quantities and types of explosives. The EMP appropriately requires the weights of delivered explosives to be accurately recorded, delivery vehicle wheels to be chocked prior to the transfer of materials, and receiving personnel to be formally designated. All HWSS personnel interviewed (two superintendents, the project engineer, and a safety representative) who were involved with explosives handling during the shaft pre-sink activities conducted in late 2020 were knowledgeable of the EMP transfer process from the commercial carrier to HWSS. HWSS’s vehicle (a large forklift) used to transport explosives from the magazine to the worksite was clean, well maintained, and properly placarded. However, contrary to DOE-STD-1212-2019, section 33.2.3.4, the forklift was not equipped with two fire extinguishers. (See **Deficiency D-HWSS-3**.) This condition could prevent quick access to a fire extinguisher and allow a fire to reach the explosive material.

Storage

HWSS’s NWP-approved EMP and work practices generally provide for adequate explosive storage. The observed magazines meet the Bureau of Alcohol, Tobacco, Firearms, and Explosives’ requirements for outdoor magazines, including the separation of powders from detonators. The total quantity of explosives is properly combined for calculating separation distances, and the locations of the magazines satisfy the

minimum distance required from inhabited buildings and public highways for the maximum allowed explosives quantities specified in the EMP. The observed magazines demonstrated HWSS's proper control of combustibles and vegetation in the magazine area, placarding (as empty during the onsite assessment), and personnel access to the magazine area. However, contrary to DOE-STD-1212-2019, section 32.2.10, which requires magazine doors to always be locked, each magazine's doors were observed unsecured and open. Magazine doors left open expose interior wood finishes to accelerated degradation. (See **Deficiency D-HWSS-4**.)

Additionally, the EMP adequately requires that all removal and addition of explosive materials from the magazines be controlled and logged. EA noted that an NWP management self-assessment (MSA), conducted in 2021, MSA-ESH-2021-024, *Explosive Safety*, identified several significant issues with the implementation of explosives inventory (e.g., missing values and signatures, incorrect quantities, items recorded in the incorrect inventory). A corrective action plan (CAP) for these issues documented the planned closure actions for each of these inventory issues. However, due to the indefinite suspension of blasting activity, the CAP was closed. Contrary to WP 15-GM1002, *Integrated Issues Management*, section 1.4.7, NWP prematurely closed the identified issues without resolution. (See **Deficiency D-NWP-1**.) Improper closure of issues can result in recurrence. NWP reopened the CAP during the onsite review.

Handling and Use

HWSS's NWP-approved EMP explosives handling and use program generally complies with the requirements of MSHA 30 CFR 57, subpart E, *Explosives*, and DOE-STD-1212-2019. The HWSS construction superintendent stated that explosives operators and handlers were appropriately trained and qualified during prior explosives operations. Because no explosives have been present in over a year, the construction superintendent stated that the intent is to retrain all explosive handlers and operators prior to any explosives being reintroduced to the site. Although ARVR-511747-005.00-03 includes a section on *Training Modules* and *Training Assessment Forms*, this section only covers the use of the emulsion machine and does not adequately address general explosive safety. All HWSS interviewed personnel (who were involved in the use of explosive materials at WIPP in September 2020) were knowledgeable of the requirements contained in the EMP, including the pre-blast warning communication system, the transportation methods, and the establishment of exclusion areas. However, contrary to ARVR-511747-040.00-01, *Worker Qualifications and Training Rev. 1*, HWSS has no records of the previous explosives training. (See **Deficiency D-HWSS-5**.) Incomplete training records could result in unqualified personnel performing explosives operations. Furthermore, the EMP does not address the restriction of operating vehicles within 25 feet of an open magazine. (See **OFI-HWSS-1**.) Vehicles with running engines can increase the risk of fire when explosives are nearby.

Explosives Safety Conclusions

HWSS implements an explosives safety program that addresses explosives transportation, storage, handling, and use. The EMP provides a well-structured framework for explosive operations, and personnel managing and handling explosives demonstrated knowledge and understanding of the requirements in the EMP. However, EA identified weaknesses associated with a lack of fire extinguishers on the explosives transport vehicle, unlocked magazine doors, premature closure of explosives inventory issues, a lack of explosives training records, and a lack of restrictions on running vehicles adjacent to the magazines.

4.0 BEST PRACTICES

No best practices were identified during this assessment.

5.0 FINDINGS

No findings were identified during this assessment.

6.0 DEFICIENCIES

Deficiencies are inadequacies in the implementation of an applicable requirement or standard. Deficiencies that did not meet the criteria for findings are listed below, with the expectation from DOE Order 227.1A for site managers to apply their local issues management processes for resolution.

Harrison Western-Shaft Sinkers Joint Venture

Deficiency D-HWSS-1: HWSS did not ensure that required barrier or control lines were in place around the drop hazard area below an observed overhead welding activity. (29 CFR 1926.1424(a)(2)(ii) and 1926.1425(b) and (d))

Deficiency D-HWSS-2: HWSS did not have required respirable crystalline silica exposure monitoring data. (10 CFR 851.21(a)(1))

Deficiency D-HWSS-3: HWSS did not ensure that the explosive transportation vehicle was equipped with two fire extinguishers. (DOE-STD-1212-2019, section 33.2.3.4)

Deficiency D-HWSS-4: HWSS did not lock the doors to the magazines. (DOE-STD-1212-2019, section 32.2.10)

Deficiency D-HWSS-5: HWSS did not retain records for employee explosives training. (ARVR-511747-040.00-01, section 5)

Nuclear Waste Partnership, LLC

Deficiency D-NWP-1: NWP prematurely closed explosive inventory related issues identified in MSA-ESH-2021-024 without resolution. (WP 15-GM1002, section 1.4.7)

7.0 OPPORTUNITIES FOR IMPROVEMENT

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

OFI-HWSS-1: Consider amending the EMP to include DOE-STD-1212-2019, section 33.1.4.1, which requires running vehicle engines to be turned off prior to the opening of a magazine when within 25 feet.

Appendix A Supplemental Information

Dates of Assessment

Onsite Assessment: March 14-17, 2022

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