Independent Assessment of Construction Safety at the Y-12 National Security Complex Uranium Processing Facility

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Office of Enterprise Assessments
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Acronyms

APMO	Acquisition and Project Management Office
BNI	Bechtel National, Inc.
CAS	Contractor Assurance System
CFR	Code of Federal Regulations
CNS	Consolidated Nuclear Security, LLC
CR	Condition Report
CWP	Construction Work Package
DOE	U.S. Department of Energy
EA	Office of Enterprise Assessments
ES&H	Environmental, Safety, and Health
FPD	Federal Project Director
FTE	Full-time Equivalent
FY	Fiscal Year
H&R	Hoisting and Rigging
IPT	Integrated Project Team
ISM	Integrated Safety Management
JHA	Job Hazard Analysis
LL	Lesson Learned
LOTO	Lockout/Tagout
MEB	Mechanical Electrical Building
MPB	Main Process Building
NFPA	National Fire Protection Association
SME	Subject Matter Expert
SRL	Self-Retracting Lifeline
STARRT	Safety Task Analysis Risk Reduction Talk
STR	Subcontractor Technical Representative
UPF	Uranium Processing Facility
Y-12	Y-12 National Security Complex

INDEPENDENT ASSESSMENT OF CONSTRUCTION SAFETY AT THE Y-12 NATIONAL SECURITY COMPLEX URANIUM PROCESSING FACILITY

Executive Summary

The U.S. Department of Energy Office of Enterprise Assessments (EA) conducted an independent assessment of construction safety at the Uranium Processing Facility (UPF) project at the Y-12 National Security Complex from August 9-13, 2021. This assessment included subcontracted construction activities of Bechtel National, Inc. (BNI), a subcontractor to Consolidated Nuclear Security, LLC (CNS). Additionally, this assessment evaluated construction safety Federal oversight of the UPF project by the National Nuclear Security Administration's Y-12 Acquisition and Project Management Office.

EA identified the following strengths, including one best practice:

- Lessons learned are specifically included in work packages, ensuring that the workforce is aware of the lessons learned and reinforcing the value of the lessons learned process. (Best Practice)
- The BNI Environmental, Safety, and Health (ES&H) group is well staffed with subject matter experts who are qualified in all aspects of construction safety.
- Safety Task Analysis Risk Reduction Talk cards effectively address safety concerns and were consistently used during observed work.
- Safety and health requirements are appropriately flowed down to sub-tier contractors.

EA also identified several weaknesses and one finding as summarized below. The finding warrants a high level of attention from CNS and BNI management.

- CNS's assessments schedule lacked a suite of assessments related to high-consequence construction safety activities. (Finding)
- Required quarterly inspections of three pieces of fall protection equipment were not conducted.
- Barricades were not always established prior to the start of work tasks.
- Control of industrial hygiene hazards, including silica, welding fumes, and concrete splash (eye) hazards, was not always effective.
- EA observed instances where hot work activity was performed contrary to site procedures.
- The Y-12 Acquisition and Project Management Office does not effectively roll up the results of weekly site walkthrough awareness activities based on risk and priority and does not effectively communicate these issues to the contractor so that problems are evaluated and corrected on a timely basis.

In summary, CNS and its construction subcontractor have developed and implemented a satisfactory construction safety program for the UPF construction project; and Y-12 Acquisition and Project Management Office has provided effective oversight. However, until the concerns identified in this report are addressed or effective mitigations are put in place, workers can potentially be exposed to hazards mentioned above. EA will follow up on the finding noted in section 3.5, Contractor Assurance System, in fiscal year 2023.

INDEPENDENT ASSESSMENT OF CONSTRUCTION SAFETY AT THE Y-12 NATIONAL SECURITY COMPLEX URANIUM PROCESSING FACILITY

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 construction safety at the Uranium Processing Facility (UPF) at the Y-12 National Security Complex (Y-12). This assessment was requested by the National Nuclear Security Administration Production Office Manager.

Consolidated Nuclear Security, LLC (CNS) is the management and operating contractor for Y-12. CNS awarded a subcontract to Bechtel National, Inc. (BNI) to construct the UPF. BNI selects and manages sub-tier subcontractors who provide construction services to UPF. Consistent with the *Plan for the Construction Safety Assessment at the Y-12 Uranium Processing Facility (July 2021)*, this assessment evaluated CNS's and BNI's implementation of the DOE requirements to control construction hazards with respect to work activities at UPF, a capital asset project at Y-12. This assessment included BNI self-performed and subcontracted construction activities. EA also reviewed the National Nuclear Security Administration's Y-12 Acquisition and Project Management Office (APMO) construction work oversight processes.

The UPF is being built to replace World War II era uranium processing operations at Y-12. The National Nuclear Security Administration has committed to deliver UPF by the end of 2025 through a series of seven subprojects, three of which have been completed. The ongoing subprojects include: the Mechanical Electrical Building (MEB), Process Support Facility, Salvage and Accountability Building, and the Main Process Building (MPB).

Planning calls and document collection began in June 2021, and the onsite assessment was conducted from August 9-13, 2021. Some of the document reviews, meetings participation, and interviews were conducted remotely prior to the onsite assessment activities.

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, findings, deficiencies, and opportunities for improvement" as defined in DOE Order 227.1A.

As identified in the assessment plan, this assessment considered selected objectives and criteria from within 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 (ISM). EA also used elements of CRAD EA-30-07, Rev. 0, *Federal Line Management Oversight Processes*, to collect and analyze data on Y-12 APMO's oversight activities related to construction safety. EA also used selected objectives and criteria from within sections of CRAD EA-32-03, Rev. 1, *Industrial Hygiene*, and CRAD EA-30-01, Rev. 1, *Contractor Assurance System*. Electrical safety standards and regulations used for this assessment include: 10 CFR 851, *Worker Safety and Health Program*; National Fire Protection

Association (NFPA) 70E-2015, *Standard for Electrical Safety in the Workplace*; and Occupational Safety and Health Administration 1910 Subpart S, Electrical, and 1926 Subpart K, Electrical.

EA observed work activities and examined key documents, including contracts, construction work packages (CWPs), procedures, manuals, analyses, policies, and training and qualification records. EA also interviewed key personnel responsible for developing and executing the associated programs and attended selected meetings. The members of the assessment team, the Quality Review Board, and management responsible for this assessment are listed in appendix A.

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

3.0 RESULTS

3.1 Flowdown of Construction Safety Requirements to Subcontractors

The objective of this portion of the assessment was to verify that CNS and BNI have appropriately flowed down DOE construction safety requirements to their sub-tier construction subcontractors.

Contracts for both CNS and BNI, a major subcontractor, include the appropriate DOE safety and health requirements, including compliance with 10 CFR 851 and the Department of Energy Acquisition Regulation (DEAR) Clause 970.5223-1, *Integration of Environment, Safety, and Health into Work Planning and Execution*. Both CNS and BNI have an approved environment, safety, and health (ES&H) plan, which appropriately addresses ISM and other safety and health requirements. BNI has effectively established its own procedures, approved by CNS, to meet the construction safety requirements of its contract.

BNI appropriately flows down construction safety requirements to sub-tier subcontractors through Contract General Condition 1, *Independent Contractor*; Supplemental Condition SC-11, *Environmental, Safety and Health (ES&H)*; and Appendix B-1, *Subcontractor Safety and Health (S&H) Requirements*, which is a comprehensive listing of safety and health requirements. Potential bidders must acknowledge adoption of the UPF ES&H program, plans, and procedures by signing Form G-2, *Safety Program Acknowledgement*. Two examples of effective flowdown of BNI construction safety requirements to sub-tier contractors are the Hartman Walsh Painting Company subcontract with TJ Wies Contracting Inc., and the FM Sylvan, Inc. stainless steel floor plate subcontract with The Liburdi Group.

The BNI Y-12 subcontracting website for potential bidders and subcontractors includes a list of UPF safety procedures, but some of these procedures are not the most recent revisions. Although mechanisms are in place to notify subcontractors of procedure changes (Procedure/Document Awareness Notification process), BNI acknowledged that subcontractors are told that they can obtain the latest copy of procedures on the external website. BNI has issued a condition report or CR (CR-03312) to address this issue.

Flowdown of Construction Safety Requirements to Subcontractors Conclusions

Contracts for CNS and BNI include the appropriate DOE ES&H requirements, including compliance with ISM and 10 CFR 851. Construction safety requirements are appropriately flowed down to the sub-tier subcontractors.

3.2 Construction Safety Requirements Implementation

The objective of this portion of the assessment was to verify that CNS and BNI and sub-tier subcontractors implement construction safety requirements at the UPF. Topics assessed include oversight of construction safety performance, work package content and implementation, and general construction work performed by BNI and sub-tier subcontractors.

Oversight of Construction Safety Performance

CNS and BNI maintain a staff of safety professionals assigned to the UPF. The BNI safety staff includes qualified personnel, including a senior industrial hygienist and a senior safety specialist dedicated to subcontracted work. CNS procedure PL-SH-801768-A008, *Uranium Processing Facility Project CNS ES&H Oversight Plan*, adequately describes the CNS oversight activities. CNS and BNI safety representatives demonstrated knowledge of construction safety during the EA walkdowns of the subcontract work. EA reviewed the reports for two Zero Incidents Program walkdowns, three ES&H walkdowns, two management awareness reports (focus-based observations), and two management assessments. The Bechtel Zero Incidents Program is based on the concept that all incidents are preventable. Zero Incidents Teams comprised of management, first line supervisors, and craft representatives observe work for hazardous conditions. All reviews included appropriate team representation, relevant safety focus areas, and a sufficient level of detail. These reviews identified areas for improvement, and these issues were appropriately addressed with a CR in the corrective action system.

BNI provides effective oversight of subcontractor performance using subcontractor technical representatives (STRs) and safety professionals. BNI procedure UPF-PROCUREMENT-PROC-7.54, *Subcontract Coordinator/Subcontract Technical Representative Program*, adequately describes the STR duties. A BNI STR is assigned to each subcontract. EA walked down work performed by seven subcontractors, and the assigned STR or lead STR participated in each walkdown, demonstrating knowledge of the project and the safety aspects of the work. EA reviewed seven CWPs and found that the STRs signed off on the CWPs and job hazard analyses (JHAs). BNI STRs prepare daily reports on subcontractor performance, including safety performance. BNI provided evidence of daily reports for subcontractors Apollo Sheet Metal, Inc., Hartman Walsh Painting Company, F. E. Moran, Inc. Special Hazard Systems, PCI Promatec, Geiger Brothers Mechanical Contractors, Inc., and FM Sylvan, Inc., including a rating of safety performance as well as one instance of a safety issue notification.

Work Package Content and Implementation

CWPs developed by BNI and subcontractors appropriately addressed work scopes and JHAs. CWPs are developed in accordance with Y17-95-64-800, *UPF Construction Work Control Program*. Reviewed CWPs contained adequate work scope descriptions. The overarching craft-specific JHAs, developed from the BNI Hazard Tree for repetitive craft work, adequately documented the main hazards with evidence of input from ES&H, management, and craft. The JHAs reviewed were comprehensive and adequately covered tasks assigned to the craft. The CWPs also included completed pre-job brief and post-job brief forms to record important aspects of the work. The CWPs contained a Non-Daily Permit log (daily permits, such as hot work, are not retained in CWPs), and permits such as the Site Excavation Notice are added to the CWP for use in the field. Some sub-tier subcontractors identified work activities and hazards that had not been addressed by the BNI Hazard Tree, and appropriately added these specific hazards and controls to the JHA. Examples include the Apollo JHA, which addressed ductwork installation and the removal of fireproofing, and the FM Sylvan, Inc. JHA, which added the activity of heating plates to remove trapped water beneath them.

Relevant lessons learned (LLs) were appropriately included in the BNI and subcontractor CWPs in accordance with procedure Y17-95-64-800. For example, a structural steel roofing CWP included three applicable LLs: cutting and machining of hard materials, such as stainless-steel parts; bypassing hold points on critical lifts; and a dropped bolt from an aerial lift. Other relevant LLs were included in subcontractor CWPs (i.e., one used by Geiger Brothers Mechanical Contractors, Inc. and three used by TJ Wies Contracting Inc). The direct inclusion of applicable LLs into the CWPs makes it easy for the supervisor or foreman to include the LLs in the pre-job briefing, ensuring that the workforce is aware of the LLs and reinforcing the value of the LL process. **(Best Practice)**

BNI and subcontractors use Safety Task Analysis Risk Reduction Talk (STARRT) cards each day for hazard recognition and development of controls for that day's tasks. EA observed crew members reviewing and signing STARRT cards during pre-work meetings for five work activities (PCI insulation; diesel generator crane lift; and three electrical activities, including MEB electrical work, continuity check on wiring from breaker to disconnect switch, and Shermco Industries troubleshoot and repair on a protective relay on a circuit breaker cubicle). Overall, the STARRT cards appropriately addressed the identified hazards for the work activities. EA observed that STARRT cards were consistently used for both direct and subcontract work, and signed STARRT cards were available at each work location. However, STARRT cards reviewed for welding were inconsistent in identifying the need for local exhaust ventilation, and in one case, a powered air purifying respirator was incorrectly specified on the STARRT card (this respirator was intended for removing fire coatings, not welding).

The BNI and subcontractor CWPs were effectively implemented in the field with observed pre-job briefs that were thorough and appropriately focused on hazards and controls. CNS and BNI managers, supervisors, and foremen were dedicated to establishing and maintaining a safe work environment, as demonstrated by management's prompt actions to correct issues identified by EA during walkthroughs. Additionally, EA observed several examples of stopping or pausing work to ensure that safety concerns were addressed. All craft and field supervisors interviewed understood that they could and would stop or pause work when they had a concern, without fear of reprisal.

The BNI ES&H group is well staffed with subject matter experts (SMEs) who are qualified in all aspects of construction safety. This subject matter expertise was demonstrated by frequent requests for technical safety information and procedural support from craft and management, which were appropriately provided by the ES&H group. Safety concerns identified by CNS and BNI safety staff during EA's observations were corrected on the spot.

Management of changes to CWPs was adequately controlled. Foremen checked out CWPs at the start of the shift for use in the field, referenced them as needed, and returned them at the end of the shift to document control. Document control updates the packages with revised drawings and documents, if needed, for issue the next day.

General Construction

In general, construction safety hazard controls were effectively implemented by BNI for excavations, hoisting and rigging (H&R), cranes in construction, fall protection, scaffolds, material handling, steel erection, and other construction activities, and followed established Occupational Safety and Health Administration standards invoked by 10 CFR 851.23.

Excavations (29 CFR 1926 Subpart P)

Excavation permit processes were followed, pre-use inspections were conducted, and barricades and shoring were properly used. Observed excavations were performed with a required Y-12 Excavation

Permit and Site Excavation Notice in accordance with Y17-95-64-822, *UPF Site Excavation and Backfill*. Reviewed *Daily Excavation Inspection Sign-Off Tags* were appropriately signed, demonstrating that an excavation-competent person conducted daily trench inspections. Appropriate warning signs were installed on barricades, and barricades were six feet from the edge of the excavation. Adequate access and egress were provided by appropriately sloped ramps. One observed trench required the use of a trench box (shields designed to protect workers from the pressure and weight of soil in the event of a cave-in) for workers installing an electrical manhole. The contractor appropriately used trench-box tabulated data to ensure that shoring on each end of the trench box was adequate based on the depth and configuration of this section of the trench. The work observed by EA involving trenching and excavations complied with the requirements of 29 CFR 1926 Subpart P.

Hoisting and Rigging (29 CFR 1926.251 and Subpart CC)

Required documents for H&R equipment were available, and equipment was properly labeled and inspected by qualified riggers. Certificates of conformance and proof test documents were maintained for lifting fixtures and other H&R equipment. Wire rope slings, synthetic slings, chain falls, spreader bars, and specialty fixtures were properly labeled with maximum lifting capacities and had permanently affixed labels. The H&R equipment was inspected quarterly by a qualified competent person rigger in accordance with Y17-95-64-875, *UPF Control of Hoisting and Rigging Equipment*.

The H&R equipment was issued from the rigging loft to qualified riggers for safe use. Qualified riggers or competent person riggers were observed inspecting H&R equipment prior to use. Where chain falls were used to lift and suspend equipment into position, the equipment was observed to also be lashed in place to prevent movement and allow work to proceed safely. Softeners (rigging protectors used at sharp bends during a lift) were appropriately used to protect the rigging from damage on the corners of a stainless-steel gantry beam. Beams used for supporting and transporting items were clearly labeled "Not For Lifting." The work activity observed by EA involving H&R complied with the requirements of 29 CFR 1926.251 and Subpart CC.

Cranes in Construction (29 CFR 1926 Subpart CC)

Crane operations complied with 29 CFR 1926 Subpart CC and UPF procedures. Crane operations, including inspections, use of tower and mobile cranes, and development of lift plans, were performed in accordance with DOE-STD-1090-2011, *Hoisting and Rigging* (listed in the UPF Design Code of Record PL-RM-801768-A001), and UPF documents. The two tower cranes on site were adequately inspected using the *Daily Tower Crane Inspection Checklist* and the *UPF Tower Crane Operations STARRT Card*, which ensure that the cranes can be operated safely. Mobile cranes were also inspected daily, with results properly recorded on form CFN-1145, *Mobile Crane Daily/Pre-Use Inspection Checklist*, in accordance with Y17-95-64-872, *UPF Crane Use and Operation*. Three mobile cranes accessible to EA displayed current annual crane inspection tags and appropriate load charts in the crane cabs. Three mobile crane operators (two who were interviewed by EA and one associated with a critical lift) were verified to possess current certifications by the National Commission for the Certification of Crane Operators. Mobile cranes in use were properly barricaded to restrict access to the swing radius of the rear rotating superstructure.

BNI implements a more robust approach to lift plans than that specified in DOE STD-1090-2011. Crane lift requirements are adequately addressed in Y17-95-64-871, *UPF Construction Hoisting and Rigging Work Operations*, using a three-tiered lift plan structure for the risk categories (low, medium, and critical lifts). Each lift risk category defines applicable criteria that are more restrictive than expectations in DOE-STD-1090-2011, such as weight limits and specialized rigging. This approach provides enhanced lift hazard controls. **(Best Practice)**

Prior to observing the critical lift for placement of the diesel generator enclosure, EA attended the STARRT meeting during which the person in charge identified the signalman/bellman to all participants (this is the person who directs the movement of the crane). The critical lift plan (HPL-00142) was written in accordance with the requirements of DOE-STD-1090-2011. The critical lift plan appropriately specified use of mats to provide soil load bearing capacity, the calculated total weight of the load and rigging, the maximum swing radius and crane orientation, and the detailed use of spreader bars and rigging. A change to add appropriately rated slings to the chain fall was approved by the BNI Project Rigging Engineer and documented on form CNF-1092, *UPF Pre-Lift Checklist*. This change was explained during the pre-lift meeting, and the lift proceeded without incident.

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

Observed fall hazards associated with wall and floor openings were appropriately controlled by restricting access. Scaffold material was used as an administrative barricade in front of all observed wall openings, and ¾ inch plywood was installed over all observed floor openings. Signage associated with observed access restrictions was adequate.

Further, BNI appropriately installed a fall arrest system (a restraint lanyard) on a new fixed ladder in the MEB (which extends more than 24 feet in height) in accordance with 29 CFR 1910.28(b)(9)(i)(D). It is noteworthy that construction planning addresses this fall protection requirement for new installations. EA also observed the following examples of workers properly using required fall protection equipment:

- Aerial lift operators used a lanyard attached to anchor points in the basket, in accordance with 29 CFR 1926 Subpart M.
- Scaffold erection workers used fall protection harnesses at all times when climbing and working at heights above 10 feet, in accordance with 29 CFR Subpart L (1926.451(g)(1)).
- Steel erection personnel used an appropriate fall protection system for installing decking and structural steel on roof sections in areas with unprotected sides and edges 15 feet above lower levels, in accordance with 29 CFR 1926 Subpart R.

Finally, BNI performed pre-use inspections of most fall protection equipment in a timely manner. EA observed BNI personnel performing daily pre-use inspections of fall protection equipment. The quarterly inspections required by UPF-Manual-SH-A001, *Elevated Work Manual*, section 3.8, were generally up to date. However, one non-leading edge self-retracting lifeline found on the roof of the MPB and one fall protection harness in the MEB were not current on the quarterly inspection. Also, the carabiner used to hold two self-retracting lifelines on the scaffold erector's harness had no evidence of a quarterly inspection. (See **Deficiency D-BNI-1**.)

Scaffolds (29 CFR 1926 Subpart L)

Work observed by EA involving scaffolds complied with 29 CFR 1926 Subpart L and was conducted safely. Scaffolds were equipped with handrails and midrails, compliant with 29 CFR 1926.451 and Y17-95-64-831, *UPF Scaffold Control and Management*, appendix F. Scaffolds were appropriately equipped with toeboards and/or netting for falling object protection. Further, scaffolding was appropriately inspected and tagged prior to use by a scaffolding competent person, who also performed daily scaffold inspections in accordance with Y17-95-64-831. Barricades around scaffold erection areas were effective in controlling falling object hazards. Scaffold stair systems were appropriately used for access inside and outside buildings and to roofs. Stairs that were being installed were safely barricaded with a sign stating, "Incomplete Stairs, Do Not Use." Scaffolding users were observed checking the

scaffold inspection tag for the required date and signature of the scaffolding competent person, demonstrating safe worker practice awareness and behavior.

Material Handling and Material Handling Equipment (29 CFR 1926 Subpart H and 1926.602)

Observed material handling and material handling equipment complied with the requirements of 29 CFR 1926 Subpart H and 1926.602. Material storage areas were clean and well organized. Roadways used by material handling equipment are separated from pedestrian walkways by rigid barricades; traffic stops are provided for pedestrians. Operator signatures on inspection logs for all-terrain powered industrial trucks demonstrate the performance of daily inspections that confirm the equipment was safe to operate. Load charts were available in the cab, and the operators wore seatbelts. Operators' training cards documented their qualifications. Operators had appropriate equipment readily available to secure loads to the powered industrial trucks.

Steel Erection (29 CFR 1926 Subpart R)

The setting of three roof modules as one unit into the southwest corner of the MPB roof was conducted safely and complied with the requirements of 29 CFR 1926 Subpart R. A partial bolt-up was adequately performed while the crane supported the load. Three connections were bolted and pinned in place from aerial lifts for this semi-triangular shaped section, without workers getting under the crane-suspended load.

Barricades (UPF-CP-214)

Barricades were effectively erected per UPF-CP-214, *Barricades and Signs*, with two exceptions noted below. Walkways around the site are delineated with barriers to separate workers from vehicle traffic. Significant use of netting was observed on elevated work surfaces, aerial lifts, and scaffolds to protect people from falling objects. Tool tethers and bags were commonly used. Additionally, BNI requires a barricade to be placed at a distance of one foot from the hazard area for every two feet of elevation. If this requirement cannot be followed, an overhead safety watch is an acceptable compensatory measure. EA observed multiple uses of safety watches, which were approved on the STARRT card by the supervisor and ES&H. However, EA observed work occurring on a scaffold in the MEB and use of an aerial lift on the third floor of the MPB without erecting barricades prior to the start of the work task, contrary to UPF-CP-214. (See **Deficiency D-BNI-2**.)

Welding and Cutting (29 CFR 1926 Subpart J)

Welding, grinding, and cutting were generally performed in accordance with documented permit forms, CFN-1139, *UPF Hot Work Permit*. Forms reflected the current revision number and were properly completed for welding and grinding activities. However, the following weaknesses were observed (see **Deficiency D-BNI-3**):

- In two locations, hot work was performed within 35 feet of combustible material (plywood and a wooden box) without the use of a fire blanket, contrary to procedure Y17-95-64-877, *UPF Hot Work Permit*, sections 4.1.9 and 4.1.
- A worker assigned as a fire watch had not signed the hot work permit, contrary to procedure Y17-95-64-877, section 3.7.
- Orange vests were not worn by two fire watches, and in two locations, the fire watch was not directly observing hot work activities, contrary to UPF-CP-227, *UPF Safety Watches*, section 3.1, which requires the fire watch to be readily identified wearing orange vests and to directly observe hot work activities to ensure that fire-safe conditions are maintained.

Training (UPF-CP-102)

The CNS and BNI training program provides adequate training for construction safety activities. In accordance with UPF-CP-102, *ES&H Orientation, Training, and Development*, all project personnel with unescorted access to the site are required to take the Construction ES&H Orientation training. Procedure Y90-95-027, *UPF Training Program*, provides an adequate training process for UPF construction personnel with regard to construction safety. Training records for eight employees (STR, pipe fitter, rigger, competent person rigger, fall protection inspector, two qualified electrical workers, and fire watch) showed that these employees had completed the appropriate training courses. Additionally, EA observed employees wearing their "rainbow training card," a color-coded craft status training card that provides easy visual confirmation of training status.

The BNI Y-12 website for subcontractors provides a table of required training (TGUI-SH-801768-A001, 10.0 Attachment 1 – Training Table), which includes the Construction ES&H Orientation training and General Subcontractor Training (general employee training). The table appropriately includes required training in industrial hygiene (IH), lockout/tagout (LOTO), rigging, confined space, fall prevention, aerial work, and fire watch. Even though subcontract craft workers were hired at the journeyman level from the union halls, each received Y-12 UPF-specific training.

Construction Safety Requirements Implementation Conclusions

CNS and BNI provide adequate oversight of subcontractor performance using STRs and safety professionals. The BNI Environmental, Safety, and Health (ES&H) group is well staffed with subject matter experts who are qualified in all aspects of construction safety Managers, supervisors, and foremen are dedicated to maintaining a safe work environment as demonstrated by the prompt correction of issues identified during walkthroughs. Craft supported these efforts, were receptive to improvements, and provided requested information. CWPs developed by BNI and subcontractors appropriately addressed work scopes and JHAs. Applicable LLs were directly included into CWPs and were communicated to work groups in pre-job briefings. The direct inclusion of applicable LLs into the CWP is a best practice.

Overall, construction safety activities, including excavations, H&R, cranes in construction, fall protection, scaffolds, material handling, steel erection, and training, are conducted safely and effectively. BNI implements a more robust approach to lift plans than that specified in DOE STD-1090-2011, including the use of a three-tiered lift plan structure for the risk categories (low, medium, and critical lifts). This approach provides enhanced lift hazard controls and is a best practice. However, issues were found with fall protection equipment inspections, control and use of barricades, and compliance with hot work procedures.

3.3 Industrial Hygiene

The objective of this portion of the assessment was to verify that BNI implements IH requirements for work involving the potential for heat stress, eye, silica, and toxic welding fume exposures.

For the observed concrete work, BNI provided adequate heat stress and eye splash hazard controls (with one exception) for concrete workers. For a concrete pour on the MPB roof, BNI installed a large canopy in the middle of the roof to provide shade for workers, a large cooler of iced-down bottled water was positioned nearby, and a portable air conditioning unit was set up as a cooling station for the workers. Additionally, large walk-in refrigerators stocked with cases of bottled water were positioned in various buildings around the construction site, giving workers ready access to cool water. The concrete pour on

the MPB roof appropriately controlled exposure to concrete splash hazards using face shields, safety glasses, and gloves. However, the eyewash was located about 300 feet away (contrary to Z358.1 requirements of approximately 55 feet) from where the concrete pour was occurring, and one open grid of rebar (un-poured roof section) was located between the eyewash and the workers. (See **Deficiency D-BNI-4**.)

BNI did not ensure that workers adequately controlled potential concrete silica dust exposures during one work evolution. Subcontractor employees were observed drilling small holes into concrete using a hammer drill, which created a potential silica exposure hazard. No vacuum shroud, water controls, or respiratory protection was used as required by the craft JHAs. (See **Deficiency D-BNI-5**.) No additional examples of uncontrolled silica exposure were observed.

In general, BNI adequately controlled hazards associated with welding. Welding is performed by multiple crafts with the same BNI Hazard Tree controls applied to welding activities in the JHAs of each craft, such as JHA-00560, *Ironworker JHA*; JHA-00565, *Pipefitter JHA*; and JHA-00558, *Electrician JHA*. BNI's senior industrial hygienist, who is certified and has significant experience, determined that respiratory protection was not required for the stainless-steel floor welding in the MPB, and provided sufficient evidence of personal air sampling monitoring results for hexavalent chromium that supported this determination. Additionally, multiple instances were observed where welding JHA requirements were followed as written. However, four instances were observed with three different crafts inside three different buildings where local exhaust ventilation was not used in accordance with the craft JHAs. (See **Deficiency D-BNI-6**.) In an effort to address this issue, BNI conducted a stand down with their welders regarding the requirements of local exhaust ventilation.

Industrial Hygiene Conclusions

BNI adequately implements IH requirements for work involving the potential for heat stress, eye, silica, and toxic welding fume exposures, with some exceptions. BNI did not provide a nearby eyewash station for concrete workers, did not ensure that workers adequately controlled potential concrete silica dust exposures during one work evolution, and did not implement local exhaust ventilation controls for some welding evolutions.

3.4 Electrical Safety

The objective of this portion of the assessment was to evaluate the implementation of the Y-12 UPF construction electrical safety program, including the installation of arc flash warning labels on certain electrical equipment, safe provision of temporary power, and work performance on de-energized electrical equipment.

The Y-12 UPF construction electrical safety program (UPF-MANUAL-CM-001, *UPF Construction Electrical Safety Manual*) effectively integrates the requirements of 10 CFR 851 and NFPA 70E-2015, section 110.1, *Electrical Safety Program*. Additional procedures effectively implement these requirements, including UPF-CP-205, *Personal Protective Equipment and Safe Work Apparel*; UPF-CP-214, Y17-95-64-823, *UPF Safety Task Analysis and Risk Reduction Talk-Job Hazard Analysis Program (STARRT-JHA) Process*; and Y17-95-64-801, *UPF Construction Phase System and Equipment Safety Lockout-Tagout*. BNI employs an adequate staff of SMEs and Authorities Having Jurisdiction who are qualified in all aspects of electrical safety to ensure effective implementation of the electrical safety program.

Construction electricians appropriately installed arc flash warning labels on all observed 208V and greater, three-phase electrical panels, disconnect switches, motor control centers, and switchgear as

required by NFPA 70E-2015, section 130.5(D). These labels adequately specified warnings and guidance for maintenance and operations personnel regarding the potential arc flash hazard, arc flash boundary, and required personal protective equipment for anyone working on or operating equipment within the arc flash boundary.

Safe temporary power is provided throughout the construction site. Temporary power transformers were enclosed in rigid handrail that separated 480V equipment from 120/208V equipment. Appropriate warning signs were posted to limit 480V equipment access to only qualified electrical workers. Other signs designated the use of 120/208V for construction workers. Additionally, ground-fault circuit interrupters were appropriately used on power cords.

Construction electricians effectively implemented electrical safety requirements during electrical testing, troubleshooting, and conductor termination work activities performed on de-energized electrical equipment. For eight observed electrical work activities, qualified electricians performed the work appropriately for the risks associated with electrical hazards and in accordance with the requirements of the construction electrical safety program. During each observed work activity, electricians (1) verified that previously applied energy control (LOTO) was properly installed and provided the required protection; (2) ensured compliance with all LOTO requirements; (3) used appropriate personal protective equipment for shock and arc flash hazards; and (4) implemented safe work practices, including redundant zero energy checks that were verified by a second qualified worker.

Electrical Safety Conclusions

The Y-12 UPF construction electrical safety program effectively integrates the requirements of 10 CFR 851 and NFPA 70E-2015. Construction electricians appropriately installed arc flash warning labels on requisite equipment. Safe temporary power is provided throughout the construction site. Construction electricians effectively performed work on de-energized electrical equipment.

3.5 Contractor Assurance System

The objective of this portion of the assessment was to verify that CNS has established a contractor assurance system (CAS) to plan and conduct assessments related to construction safety. Additionally, the objective of this section is to assess how the CAS identified and managed construction safety issues and associated corrective actions and analyze CAS results to provide feedback on the adequacy of controls and to improve safety management.

CNS has implemented a functioning CAS for providing feedback and improvement input on the safety of construction work at the UPF project. Issues are captured in CRs, which are appropriately reviewed by the UPF Condition Report Review Committee (CRRC). EA attended the UPF CRRC meeting during the assessment and reviewed 69 CRs designated as emerging and open. The CRRC effectively determined the significance levels for all CRs and assigned a responsible manager and a responsible person to oversee the corrective actions. Additionally, each CR was effectively addressed in the CNS ActionWay issues management system.

BNI uses an innovative online application, Chekhov, for preparing, scheduling, and documenting construction safety walkthroughs and any resulting safety issues identified. This application stores checklists that BNI management and ES&H personnel can use to select a relevant topic for the focus of their daily safety walkthroughs. Results of walkthroughs are easily recorded in the Chekhov application and can be trended to identify changes in safety performance.

Based upon CAS-QA-801768-FY20-002, *FY21 Integrated Assessment Schedule*, the CNS CAS is not based on a risk-informed approach for scheduling construction safety assessments, contrary to DOE Order 226.1B, *Implementation of Department of Energy Oversight Policy*. For fiscal year (FY) 2021, the assessment schedule lacked a suite of assessments related to high-consequence construction safety activities (see **Finding F-CNS-1**). Only 7 of 176 scheduled assessments and audits were related to construction activities with the potential for significant impacts to worker safety and health. For example, CNS did not conduct assessments in high-risk areas such as hot work and silica exposure. Additionally, issues identified by BNI management and ES&H personnel during their daily walkthroughs and recorded in Chekhov were not entered in the CNS CAS. Therefore, many of the issues identified, which provide construction safety trends, were not effectively used to improve performance. CNS has created a condition report and is addressing this issue.

Contractor Assurance System Conclusions

CNS has implemented a functioning CAS for providing feedback and improvement input on the safety of construction work at the UPF project. However, the CAS lacks a suite of assessments related to construction safety to ensure that UPF construction project work is being performed safely and in compliance with all requirements. BNI management and ES&H personnel are actively gathering and recording safety performance data and using an innovative online application to trend results. However, this information is not input into the CAS, thereby diminishing its effectiveness in ensuring worker safety and health for UPF construction personnel.

3.6 Y-12 APMO Project Oversight

The objective of this portion of the assessment was to assess the Y-12 APMO oversight process for construction safety at the UPF site and the implementation of specific Y-12 APMO programs, including assessments, operational awareness activities, and issues management.

Procedure PL-PJ-801768-A006, *Uranium Processing Facility Project Execution Plan, Project Number 06-D-141*, appendix B, *UPF Charter*, clearly defines the organizational structure, roles and responsibilities, and procedures for the Integrated Project Team (IPT). The ES&H Construction Division Director reports through the Technical Director to the UPF Federal Project Director (FPD). The ES&H Construction Division provides the FPD with a cadre of experienced and highly qualified SMEs who conduct field observations and perform periodic reviews and assessments of project performance.

Y-12 APMO prepared annual oversight plan Y-12APMO-PL-95-A005, *Acquisition and Project Management Office Oversight Plan*, which included two assessments in FY 2021: worker safety and health program implementation for UPF, and environmental program implementation for UPF. Y-12 APMO appropriately planned these assessments, consistent with procedure Y-12APMO-PR-A003, *APMO Oversight Planning Process*. However, the planned worker safety and health program implementation assessment was delayed for several months and not completed according to the timeline stipulated in the plan. In addition to the two scheduled assessments, one unscheduled assessment identified an ineffective use of barricades for personnel safety. Although this issue was entered into the CNS ActionWay issues management system, Y-12 APMO determined that the corrective action plan was not adequate based on its continuing observations of related non-compliances documented in weekly awareness activity walkthroughs.

Procedure Y-12APMO-PR-A004, *Oversight Execution/Reporting Process*, appropriately describes how Y-12 APMO implements DOE Order 226.1B by planning, executing, and documenting oversight results, as well as communicating issues and overseeing the contractor's corrective action efforts; however, the ES&H Construction office is not effectively communicating issues and overseeing the contractor's

corrective actions. ES&H SMEs conduct weekly awareness activity walkthroughs. The SMEs coordinate these walkthroughs with BNI ES&H counterparts and building superintendents in an ad hoc manner. Extensive construction site safety and health concerns identified during these weekly awareness activity walkthroughs are reported by email to a distribution list of Y-12 APMO, CNS, and BNI managers for situational awareness. These concerns are then used by the respective building deputy FPDs as a resource prior to their own weekly awareness activity walkthrough of their respective buildings. Historically, Y-12 APMO averaged 200 of these informal awareness activities each year. The results of these weekly awareness activities are entered into Y-12 APMO's ePegasus issues management system, but they are not categorized based on risk and priority and are not formally and effectively communicated to the contractor so that problems are evaluated and corrected on a timely basis. (See **Deficiency D-Y-12 APMO-1**.)

Y-12 APMO Project Oversight Conclusions

Y-12 APMO conducts assessments and operational awareness activities in accordance with the annual plan. One of the major oversight activities conducted by the ES&H Construction Division staff is informal, ad hoc, weekly awareness walkthroughs. The extensive construction site safety and health issues revealed during these walkthroughs are provided to the contractor for "situational awareness only" and are not ranked based on risk and priority and formally communicated to the contractor for resolution.

4.0 BEST PRACTICES

Best practices are safety-related practices, techniques, processes, or program attributes observed during an assessment that may merit consideration by other DOE and contractor organizations for implementation. The following best practices were identified as part of this assessment.

- The direct inclusion of applicable LLs into CWPs makes it easy for the supervisor/foreman to include the LLs in the pre-job briefing, ensuring that the workforce is aware of the LLs and reinforcing the value of the LL process.

- BNI implements a more robust approach to lift plans than that specified in DOE STD-1090-2011. This approach provides enhanced lift hazard controls.

5.0 FINDINGS

Findings are deficiencies that warrant a high level of attention from management. If left uncorrected, findings could adversely affect the DOE mission, the environment, the safety or health of workers and the public, or national security. DOE line management and/or contractor organizations must develop and implement corrective action plans for findings. Cognizant DOE managers must use site- and program-specific issues management processes and systems developed in accordance with DOE Order 226.1B to manage the corrective actions and track them to completion.

Consolidated Nuclear Security, LLC

Finding F-CNS-1: The CNS CAS does not include a risk-informed suite of assessments related to construction safety. (DOE Order 226.1B, Attachment 1, 2.b.(2))

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.

Bechtel National, Inc.

Deficiency D-BNI-1: BNI did not conduct required quarterly inspections on three pieces of fall protection equipment. (UPF-Manual-SH-A001, section 3.8)

Deficiency D-BNI-2: BNI did not ensure that barricades were established prior to the start of work tasks. (UPF-CP-214, section 3.1)

Deficiency D-BNI-3: BNI did not ensure that combustible material was removed or protected from hot work activities, and that fire watches signed the permit, directly observed hot work, and wore orange vests. (UPF-CP-227, section 3.1, and Y17-95-64-877, sections 4.1.9 and 4.1.10)

Deficiency D-BNI-4: BNI did not provide an eyewash station that met American National Standards Institute Z358.1 requirements within the required distance from a concrete splash hazard during observed concrete pours. (10 CFR 851.23(a) (3) and (7); 29 CFR 1910.151(c); and 29 CFR 1926.50(g))

Deficiency D-BNI-5: BNI did not ensure that subcontractor employees drilling holes into concrete followed specified engineering controls. (Y72-95-003, *Silica Exposure Control Procedure for the Construction of the Uranium Processing Facility Project*, section 3.0 and attachment A)

Deficiency D-BNI-6: BNI did not effectively implement requirements for the use of local exhaust ventilation during welding operations inside buildings. (JHA-00560, JHA-00565, and JHA-00558)

Y-12 Acquisition and Project Management Office

Deficiency D-Y-12 APMO-1: Y-12 APMO does not effectively roll up the results of weekly site awareness walkthrough activities based on risk and priority and does not effectively communicate these issues to the contractor so that problems are evaluated and corrected on a timely basis. (DOE Order 226.1B, 4.b.(4); Y-12APMO-PR-A004)

7.0 OPPORTUNITIES FOR IMPROVEMENT

There were no opportunities for improvement identified as part of this assessment.

8.0 ITEMS FOR FOLLOW-UP

EA will coordinate with Y-12 APMO on future EA assessment(s) of issues management.

Appendix A
Supplemental Information

Dates of Assessment

Onsite Assessment: August 9-13, 2021

Office of Enterprise Assessments Management

John E. Dupuy, Director, Office of Enterprise Assessments
William F. West, Deputy Director, Office of Enterprise Assessments
Kevin G. Kilp, Director, Office of Environment, Safety and Health Assessments
David A. Young, Deputy Director, Office of Environment, Safety and Health Assessments
Kevin M. Witt, Director, Office of Nuclear Safety and Environmental Assessments
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Jack E. Winston, Director, Office of Emergency Management Assessments
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