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

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Office of Enterprise Assessments
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Acronyms

APMO	Y-12 Acquisition and Project Management Office
ASME	American Society of Mechanical Engineers
BNI	Bechtel National, Inc.
CA	Corrective Action
CF	Caustic Filtration
CFI	Carolina Fabricators, Inc.
CFR	Code of Federal Regulations
CNS	Consolidated Nuclear Security, LLC
COE	Conduct of Engineering
CQP	Construction Quality Plan
CRAD	Criteria and Review Approach Document
DOE	U.S. Department of Energy
DSA	Documented Safety Analysis
EA	Office of Enterprise Assessments
FE	Field Engineer
FY	Fiscal Year
MC	Management Concern
MPB	Main Processing Building
MRR	Material Receiving Report
NCR	Nonconformance Report
NDE	Nondestructive Examination
NQA	Nuclear Quality Assurance
OFI	Opportunity for Improvement
P&ID	Piping and Instrumentation Diagram
PK	Pickling
PMI	Positive Material Identification
PO	Purchase Order
Q	Quality
QA	Quality Assurance
QAP	Quality Assurance Program
QC	Quality Control
QCE	Quality Control Engineer
RS	Risk Significant
SAB	Salvage and Accountability Building
SQR	Supplier Quality Representative
SS	Safety Significant
SSCs	Structures, Systems, and Components
TECAM	Technical Evaluation of Critical Attributes and Mitigation
UPF	Uranium Processing Facility
Y-12	Y-12 National Security Complex

INDEPENDENT ASSESSMENT OF CONSTRUCTION QUALITY 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 quality at the Y-12 National Security Complex Uranium Processing Facility (UPF) from August 28-31, 2023. Consolidated Nuclear Security, LLC (CNS) serves as the primary contractor for the UPF project and has subcontracted Bechtel National, Inc. (BNI) to manage and subcontract UPF design and construction activities. The National Nuclear Security Administration's Y-12 Acquisition and Project Management Office (APMO) has overall Federal UPF project oversight responsibilities. The primary objective of the assessment was to evaluate the effectiveness of CNS and BNI quality assurance (QA) processes for the design, procurement, installation, and inspection of select UPF piping structures, systems, and components (SSCs) related to nuclear safety. Additionally, the assessment evaluated the effectiveness of APMO oversight of CNS and BNI construction quality activities. Direction for EA independent oversight of the construction of facilities classified as high-hazard nuclear facilities under 10 Part 830, *Nuclear Safety Management*, is detailed in Sec. 303 of annual appropriations acts.

EA identified the following strengths, including one best practice:

- APMO has effectively established formal quarterly Federal oversight performance self-assessments that include well-developed metrics supporting trending and analysis of oversight activity timeliness and APMO-identified issues. (Best Practice)
- CNS and BNI have established effective UPF design verification processes that require independent reviewers to verify piping design work prior to externally releasing the design for procurement, manufacture, or construction.
- CNS and BNI QA organizations are well-established and have assigned knowledgeable quality managers to effectively implement, assess, maintain, and improve their respective QA programs.
- CNS and BNI have effective programs in place to evaluate and select suppliers of piping system items and services based on specified criteria and monitor performance of approved suppliers.
- CNS and BNI onsite welding programs and observed weld inspections performed by quality control personnel in the field meet or exceed specifications and quality requirements.

In summary, no weaknesses were identified during this assessment. CNS and BNI have closely coordinated to effectively establish and implement QA programs and processes for the construction of reviewed UPF piping SSCs related to nuclear safety. APMO has also performed effective Federal oversight of UPF piping construction quality activities. Building upon the strengths identified in this report will support the continued effectiveness of the QA processes in place for the design, procurement, installation, and inspection of SSCs related to nuclear safety at UPF.

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

1.0 INTRODUCTION

The U.S. Department of Energy (DOE) Office of Nuclear Safety and Environmental Assessments, within the independent Office of Enterprise Assessments (EA), conducted an assessment of the effectiveness of quality assurance (QA) program implementation for piping systems related to nuclear safety and associated construction activities at the Y-12 National Security Complex (Y-12) Uranium Processing Facility (UPF). Consolidated Nuclear Security, LLC (CNS) currently serves as the primary management and operating contractor for Y-12. CNS has subcontracted Bechtel National, Inc. (BNI) to construct the UPF and manage sub-tier subcontractors supporting design and construction activities. The National Nuclear Security Administration's Y-12 Acquisition and Project Management Office (APMO) has overall Federal UPF project management and oversight responsibilities. Onsite assessment activities were conducted on August 28-31, 2023.

In accordance with the *Plan for the Independent Assessment of Construction Quality at the Y-12 National Security Complex Uranium Processing Facility, July 2023*, the assessment evaluated the effectiveness of CNS, BNI, and sub-tier subcontractor implementation of the UPF quality assurance programs (QAPs) and requirements for the engineering design, procurement, receipt, storage, installation, and inspection of select Quality (Q) and Risk Significant (RS) quality level piping structures, systems, and components (SSCs) at UPF. The primary focus of this assessment was the ongoing construction of Q and RS quality level piping SSCs associated with UPF's Main Processing Building (MPB) Pickling (PK) System and Salvage and Accountability Building (SAB) Caustic Filtration (CF) System. The assessment also reviewed APMO's oversight of CNS and subcontractor QAP implementation. Direction for EA independent oversight of the construction of facilities classified as high-hazard nuclear facilities under 10 Part 830, *Nuclear Safety Management*, is detailed in Sec. 303 of annual appropriations acts.

Upon its completion, UPF will offer modernized infrastructure to ultimately replace several aging Y-12 production facilities currently in use. The UPF design segregates processes into separate buildings based on nuclear safety and security risks. The MPB will contain the most hazardous processes, and the SAB will house medium-risk processes. Current UPF construction activities are focused on the installation of key facility SSCs at MPB and SAB, including piping systems with functional and performance requirements derived from the UPF nuclear safety basis. The Q quality level designation is assigned to UPF safety significant (SS) SSC construction activities that are subject to the UPF project's highest level of quality processes and controls. The RS quality level designation is assigned to UPF SSC construction activities requiring a high level of quality controls, though not as high as the level required of Q-designated SS SSCs.

2.0 METHODOLOGY

The DOE independent oversight program is described in and governed by DOE Order 227.1A, *Independent Oversight Program*, which EA implements 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, the criteria used to guide this assessment were based on objectives SS.1 and SS.2 of EA Criteria and Review Approach Document (CRAD) 30-11, Revision 0, *Safety Systems Management Review*. In addition, elements of EA CRAD 30-07, Revision 0, *Federal Line Management Oversight Processes*, were used to collect and analyze data on APMO oversight activities. To gather relevant assessment data, EA reviewed CNS, BNI, and APMO policies, processes, procedures, and records supporting UPF QAPs, piping system engineering design, procurement and suppliers, work planning and execution, QA and quality control (QC) personnel training and qualification, and issues management. EA observed relevant piping construction and testing activities and work planning meetings. EA also interviewed key contractor, subcontractor, and Federal personnel responsible for implementing UPF QA and QC activities. 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 Engineering Design

This portion of the assessment evaluated the UPF piping engineering design program, design requirements, design verification, and design change control process.

Piping Engineering Design Program

CNS has established and BNI has effectively implemented an engineering design program for developing and controlling process piping systems in accordance with 10 CFR 830, *Nuclear Safety Management*, section 122, criterion 6. CNS procedure E-SD-0001, *Conduct of Engineering* [COE] *Program*, provides an adequate process to ensure that BNI designs Q and RS quality level piping SSCs using sound engineering principles and translates the design bases and assumptions in DSA-EF-801768-A001, *Documented Safety Analysis* [DSA] *for the Uranium Processing Facility*, into criteria for design outputs (e.g., calculations, drawings, and specifications). The CNS COE program also appropriately identifies design criteria for the procurement, installation, and operation of the reviewed CF and PK piping systems.

The CNS engineering design program has adequately defined processes for developing calculations and associated analyses, drawings, and specifications for the reviewed piping systems. UPF-3DP-G04B-00037, *Engineering Calculations*, specifies appropriate calculation requirements (e.g., pipe sizing, pipe slope, and pipe support loads) for UPF piping systems. Seven reviewed calculations included proper pressure and temperature requirements for the PK process piping system, pipe stress analysis for PK modules in the MPB, hydraulic analysis of the PK System, common pneumatic test pressure analyses, and review of engineered pipe supports. The calculations also included appropriate objectives, design inputs, assumptions, references, analytical methods, results, and conclusions for the applicable analyses. Acceptance criteria identified for tested parameters (e.g., pressure and temperature) were also adequately supported by calculations and other engineering documents to meet design bases assumptions.

UPF-3DP-G04B-00046, *Engineering Drawings*, adequately defines piping drawing requirements, including materials of construction and testing parameters. Piping and instrumentation diagrams (P&IDs), piping isometric drawings, piping layout drawings, and pipe support drawings for reviewed SSCs appropriately included materials of construction, material sizes and quantities, piping layout locations to facility grid lines, and pipe support locations. UPF-3DP-G04B-00049, *UPF Engineering Specifications*, defines adequate specification requirements for piping commodities, equipment procurement, and construction to ensure that piping systems are fabricated with materials qualified for

expected environments. Four reviewed piping construction specifications were adequately prepared and implemented for the CF and PK process piping systems. Nine reviewed technical specifications appropriately included the general requirements for piping, tubing, and valves in accordance with American Society of Mechanical Engineers (ASME) B31.3, *Process Piping*, and associated American Society for Testing and Materials material standards.

Design Requirements

CNS and BNI have appropriately identified, developed, and maintained reviewed piping design requirements in accordance with relevant technical baseline documents as directed in DOE Order 420.1C, *Facility Safety*, attachment 2, chapter V, paragraph 3.c.(2), and PL-PJ-801768-A017, *Systems Engineering Management Plan for the Uranium Processing Facility*. PL-PJ-801768-A017, section 3.7, provides an appropriate strategy for validating and verifying the UPF technical design requirements specified in PL-PJ-801768-A025, *Technical Requirements Management Plan for the Uranium Processing Facility Project*, and TS-EF-801768-A001, *Technical Safety Requirements for the Uranium Processing Facility*. Systems engineering effectively employs an automated requirements management tool, IBM DOORS®, to link these requirements. During an observed demonstration of IBM DOORS, system engineering management was proficient in using the tool to track and monitor changes to reviewed design requirements.

DE-PE-801768-A027, *UPF Piping Design Criteria, Chapter 3, Section 600 of the UPF Design Criteria*, adequately outlines UPF piping design requirements and referenced codes and standards. DE-PE-801768-A051, *UPF Piping Systems Structural Design Criteria, Chapter 3, Section 1200 of the UPF Design Criteria*, appropriately includes design requirements for process piping supports, structural and seismic loads, stress analysis criteria, load combinations, and capacity (i.e., allowable stress, moments, or other limiting features for applicable load combinations). PL-RM-801768-A001, *UPF Design Code of Record*, adequately establishes applicable regulations, DOE directives, and industry codes and standards pertinent to piping design, including ASME B31.3.

Reviewed system design descriptions (SDDs), SDD-EJ-801768-CF-B001, *System Design Description for the Caustic Filtration System*, and SDD-EJ-801768-PK-A001, *System Design Description for the Pickling System*, meet the requirements of DOE-STD-3024-2011, *Content of System Design Descriptions*, and DOE Order 420.1C. Reviewed SDDs reflect the 90% draft, as defined in DG-EG-801768-A003, *UPF System Facility Design Description Guide*, and are considered preliminary documents until the 100% revision that corresponds to the as-built design at system turnover to Y-12 operations. Twenty-eight reviewed P&IDs for the CF and PK Systems adequately identified process piping quality levels and seismic design category derived from the UPF DSA, and UPF piping design criteria.

Design Verification

CNS and BNI have established and implemented effective design verification processes in accordance with QA criteria in 10 CFR 830.122, criterion 6. UPF-3DP-G04B-00092, *UPF System Verification*, provides an adequate verification process using individuals who have relevant subject matter expertise to ensure that engineering products (calculations, drawings, and specifications) are technically accurate and completed according to ASME Nuclear Quality Assurance (NQA)-1-2008/2009a, *Quality Assurance Requirements for Nuclear Facility Applications*, requirement 3, section 500. Further, the UPF design verification processes require independent reviewers to verify piping design work prior to externally releasing the design for procurement, manufacture, or construction. Seven reviewed design calculations, 60 reviewed piping isometrics, 7 module assembly drawing packages, and 13 reviewed construction and technical specifications were appropriately verified by independent engineers before design release.

Design Change Control

CNS and BNI have adequately established and implemented a technical change control process for the UPF project. UPF-3DP-G04B-00901, *UPF Technical Change Control*, appropriately specifies configuration change control requirements in accordance with DOE-STD-1073-2003, *Configuration Management*; DOE-STD-1189-2008, *Integration of Safety into the Design Process*; and DOE Order 420.1C, chapter V. Additionally, UPF-3DP-G04B-00901 includes an effective change control process for ensuring proper engineering review and approval of proposed piping design changes, including field changes and the identification of associated affected documents.

Y17-95-69-830, *Engineering Change Document Package*, adequately supplements the process within UPF-3DP-G04B-00901 for developing engineering change document (ECD) packages. Y17-95-69-830 adequately covers the ECD process for design changes originating from engineering that do not require an engineering change proposal (ECP) as documented in UPF-3DP-G04B-00901. Two reviewed ECDs and three reviewed ECPs for piping and pipe support documentation demonstrated appropriate design change controls. Fifty reviewed field change documents demonstrated appropriate review and approval by responsible engineers to provide design control of approved field requests received from construction.

Engineering Design Conclusions

CNS and BNI have established and implemented an effective COE program, as demonstrated by: appropriately identifying, developing, and maintaining technical baseline documents for the reviewed UPF piping systems in accordance with the facility safety basis; establishing and implementing effective design verification processes that require independent reviewers to verify piping design work prior to externally releasing the design for procurement, manufacture, or construction; and adequately establishing and implementing a technical change control process that provides configuration control of issued design documents.

3.2 Quality Assurance

This portion of the assessment evaluated the effectiveness of UPF programs related to piping system QA, QA personnel qualification, procurement and verification of items and services, control of nonconformances, and control of design interfaces.

QA Programs

CNS and BNI QAPs and processes adequately incorporate the requirements of 10 CFR 830, subpart A, *Quality Assurance Requirements*, and DOE Order 414.1D, *Quality Assurance*. The CNS QAP defined in Y60-95-102PD, *UPF Quality Assurance Program Description* [QAPD], appropriately incorporates consensus standards for nuclear facilities from ASME NQA-1 2008/2009a, part I, and requirements from DOE Order 226.1B, *Implementation of Department of Energy Oversight Policy*. Y60-95-102PD adequately addresses the applicable ASME NQA-1, part II, QA requirements for specific work activities. The latest CNS QAPD revision for fiscal year (FY) 2023 was appropriately reviewed by qualified personnel and approved by APMO as required by DOE Order 414.1D.

CNS subcontract 4300092953, *Uranium Processing Facility Project Management*, appropriately requires BNI to perform construction project management in accordance with PL-QA-801768-A001, *Bechtel National Incorporated Uranium Processing Facility Project Quality Assurance Plan*, which CNS has reviewed and approved. The current revision of the PL-QA-801768-A001 effectively flows down applicable requirements from Y60-95-102PD and ASME NQA-1 for the BNI scope of work. Both Y60-95-102PD and PL-QA-801768-A001 define the special controls, processes, test equipment, tools,

and skills needed to properly verify the quality of piping system construction. CNS and BNI QA organizations are well-established and have assigned knowledgeable quality managers to effectively implement, assess, maintain, and improve their respective QAPs.

QA Personnel Qualification

Training and qualification programs for QA personnel appropriately incorporate requirements from DOE Order 426.2, *Personnel Selection, Training, Qualification, and Certification Requirements for DOE Nuclear Facilities*, and ASME NQA-1. Y90-95-027, *UPF Training Program*, provides an effective training and qualification approach that includes personnel selection, indoctrination, onboarding training, continuing training, qualification, and certification. APA-UPF-2QP-Q01B-00302, *Auditor/Lead Auditor Qualification*, appropriately specifies auditor training requirements in accordance with ASME NQA-1 and Y60-95-102PD, section 5.2. Reviewed written training programs, formal procedures, and on-the-job audits/assessments training for QA personnel provide thorough instruction on relevant UPF SSC operational features, safety requirements, and performance criteria. As required by Y60-95-102PD, the lead auditor qualification process appropriately requires participation in at least five QA audits within the three years before qualification, including one nuclear QA audit within one year before qualification. Reviewed BNI qualification forms and training certificates for six lead auditors demonstrated that they had completed adequate training for conducting QA audits and assessments.

Procurement and Verification of Items and Services

Y60-95-102PD and BNI APA-UPF-PROCUREMENT-PROC, *UPF Procurement Manual*, define an adequate process for procuring and verifying UPF items and services, including the control of documents and deliverables and the flowdown of QA requirements. PL-QA-801768-A001 appropriately references Y60-95-102PD, section 5.4, which requires that QA requirements flow down to all levels of subcontractor procurement documents. Procedure UPF-3DP-G06B-00010, *Specifying Supplier Quality Assurance Program Requirements*, provides an effective method to flow down and specify the detailed requirements to include in each supplier's QAP. Four reviewed BNI purchase orders (POs) for Q and RS quality level piping system items and services appropriately included the scope of work, right of access to facilities, technical specifications, testing and inspection activities, special processes, and quality requirements. UPF-3DP-G06B-00010 and the reviewed POs appropriately required deliverables consistent with approved QAPs/procedures and the assigned quality levels. PL-QA-801768-A001 includes an adequate program to control purchased material, equipment, and services, which meets the requirements of 10 CFR 830.122, criterion 7, and Y60-95-102PD, section 5.7.

Y60-95-102PD, section 5.7 also establishes effective processes to evaluate and select suppliers based on specified criteria and monitor performance of approved suppliers as required by 10 CFR 830.122, criterion 7. Y60-95-102PD, section 5.7.2, requires BNI to conduct periodic reevaluations, surveillances, inspections, tests, and audits of suppliers to ensure that they continue to meet technical/quality requirements. For example, BNI's latest triennial QA supplier audit report for Carolina Fabricators, Inc. (CFI) and three reviewed BNI quality surveillance reports for witness/hold points for spooled quality level Q pipe demonstrated that CFI adequately met UPF project technical/quality requirements. BNI conducted the audit and surveillances at required frequencies based on approved procedures.

Control of Nonconformances

Y17-95-64-804, *UPF Construction Nonconformance Reporting and Control*, includes adequate instructions to identify, disposition, and control nonconformances as required by ASME NQA-1 2008/2009a, requirement 15. The procedure effectively specifies control methods, including marking, nonconformance report (NCR) hold tags, NCR conditional release tags, and designated segregated

holding areas. The appropriate use of these methods was observed during field walkdowns of the SAB, MPB, and 1065C and 1065E receiving/storage buildings. Design engineering maintains an adequate procedure, UPF-3DP-G04B-00061, *Nonconformance Reports (NCRs)*, which effectively describes methods for controlling, processing, dispositioning, and incorporating required design changes for NCRs upon receipt. Fourteen reviewed NCRs for Q and RS quality level materials in the CF and PK Systems included adequate steps to identify, document, evaluate, segregate, and disposition nonconforming items as required by Y17-95-64-804. BNI field engineers (FEs) appropriately prepared these NCRs. BNI responsible engineers, CNS design authority representatives, and the QC manager or designee appropriately reviewed, approved, and submitted the NCRs to the disposition authority for final approval, disposition, and documentation in the NCR database as required by Y17-95-64-804. The reviewed NCRs also adequately documented the effectiveness of the corrective actions (CAs) taken to resolve the identified problem and prevent recurrence.

Y-15-95-816, *UPF Issues Management Process*, defines adequate processes to identify and document quality performance indicators relative to NCRs. The processes appropriately require issuing condition reports (CRs) to capture any negative trends, taking compensatory measures to mitigate risks, completing causal analyses, and developing CA plans. Y-15-95-816 is appropriately integrated with the NCR process per Y17-95-64-804. Y15-95-914, *UPF Metrics and Trending Analytics Process*, provides an effective process to identify, document, and trend any observed significant high level negative quality performance indicators relative to NCRs. Three reviewed CRs adequately documented and addressed significant negative NCR-related trends for the CF and PK Systems. For example, CF CR 25774-000-GCA-GAM-04123, *Q3 2022 NCR Trend Evaluation – Potential Mis-fabrication of Pipe Spools*, responded to a potential identified trend of 29 NCRs related to mis-fabrication of pipe spools from CFI. The CR adequately documented nonconformances discovered in the field for fabricated pipe spools. As required by Y17-95-64-804, engineering issues quarterly NCR trend analysis reports, which adequately validate reviewed NCRs issued for the UPF project. These reports appropriately categorize NCR deficiency cause codes (e.g., construction, material, design) and commodity codes, and identify any high-level trends, CRs issued, and any other actions taken to mitigate future occurrences. For example, QT-CM-801768-A010, *UPF NCR Quarterly Trend Evaluation Q2 2023*, adequately validated 507 NCRs, categorizing their causes to be construction deficiencies, material deficiencies, and design deficiencies.

Control of Design Interfaces

The processes in place to identify and control design interfaces and coordinate design information transmittals comply with 10 CFR 830.122, criteria 6. PL-PE-801768-A002, *Engineering Execution Plan for the Uranium Processing Facility Project*, appropriately includes the strategy to manage design engineering interfaces affecting the UPF project. Y60-95-102PD, section 5.3.9, *Interface Control*, adequately specifies the process and methods used to identify and procedurally control design interfaces, including assigning responsibility and establishing procedures among participating design organizations for review, approval, release, distribution, and revision of design-related documents. APA-UPF-3DP-G04B-00025, *UPF Engineering Interface Control*, adequately defines the detailed measures employed to identify and control interfaces between engineering and other internal/external organizations, such as for design reviews. ML-EG-801768-A017, *UPF Engineering Document Coordination Guide and Matrix*, provides appropriate guidance and assigns responsibilities for the coordination and review of engineering documents as well as assists in the selection of the appropriate interdisciplinary and functional stakeholders and reviewers for each type of engineering document.

CNS adequately implements formal processes to establish responsibilities between engineering and interfacing groups for review, approval, release, distribution, and revision of design documents. Y15-95-815, *CNS UPF/Y-12 Project Structure, System, and Component Interface Management Procedure*, adequately establishes requirements to issue SSC interface control documents, which implement the

formal interface requirements approach between UPF and Y-12, including boundaries, points of contact, division of responsibilities, and information needs of key stakeholders during design, construction, testing, and tie-in of each UPF system.

Quality Assurance Conclusions

CNS and BNI QAPs and processes adequately incorporate the requirements of 10 CFR 830, subpart A, and DOE Order 414.1D. CNS and BNI have effective training and qualification programs for QA personnel. BNI-procured piping system items and services meet requirements for the control of documents and deliverables and the flowdown of QA requirements. BNI has an effective program to evaluate and select suppliers of piping system items and services based on specified criteria and to monitor performance of approved suppliers. CNS and BNI have adequate processes to identify, disposition, document, and trend nonconforming conditions and take CAs. CNS and BNI have adequate processes to identify and control design interfaces and coordinate design information transmittals among participating design organizations.

3.3 Construction Quality Control

This portion of the assessment evaluated the effectiveness of CNS and BNI's construction QC plan, QC personnel qualification program, material receiving, quality verification of installed piping systems, piping acceptance testing, and supplier surveillance and audits.

Construction Quality Control Plan

Y17-95-64-810, *Construction Quality Management System*, adequately implements the requirements of PL-QA-801768-A001 and appropriately defines processes to establish and maintain the UPF construction quality management system and construction quality plan (CQP). PL-CM-801768-A013, *UPF Construction Quality Plan*, has been appropriately developed to establish the methods used to plan, perform, and document quality inspections, tests, and reviews to ensure compliance with engineering drawings and specifications. The plan applies to Q and RS quality level permanent plant SSCs and defines the level of quality inspections required for each. The plan adequately addresses requirements for QC personnel qualification, material receiving, quality verification of installed piping systems, piping acceptance testing, and subcontractor surveillance.

UPF-3DP-G04B-00918, *Technical Evaluation of Critical Attributes and Mitigation* [TECAM], is an adequate process used to identify and document critical attributes and acceptance methods of installed process piping. The critical attributes and associated acceptance methods/criteria required in reviewed TECAM documents are appropriately used as inputs to develop material requisitions, service requisitions, commercial grade dedication packages, risk significant surveillance plans, functional acceptance criteria, facility/system design descriptions, construction inspection plans, and supplier quality acceptance plan documents. Five reviewed TECAM documents for piping systems adequately specify the critical safety functions that are identified in the DSA. For example, specifications in TECAM-ED-922600-A016, *TECAM – MPB Piping Installation TECAM 1*, are appropriately implemented for conducting pipe weld visual inspections and system leak checks during installation of the Q and RS piping spools in the PK System.

QC Personnel Qualification Program

The CQP adequately identifies the roles and responsibilities of QC personnel accountable for performing surveillances and independent inspections. QC personnel appropriately evaluated reviewed construction procedures and inspection instructions, identified QC verification requirements for those activities necessary to ensure compliance with procedures, drawings, and specifications, and documented

performance of in-process and final inspections of Q and RS items and activities. Quality control engineers (QCEs) and FEs are adequately trained, certified, and qualified in accordance with Y17-95-64-809, *UPF Quality Control/Field Engineering Personnel Certification/Qualification Program*. Twenty-seven reviewed training records demonstrated adequate training and qualification of level II QC inspectors (23) and level II field engineering inspectors (4).

Material Receiving

Y17-95-64-846, *UPF Material Receiving*, appropriately defines requirements for receipt and inspection of materials, material acceptance, and processing of material receiving reports (MRRs). QCEs adequately performed inspections, verified quality documentation, and confirmed overall compliance with PO requirements for reviewed records in accordance with the approved CFN-1045, *UPF Material Receiving Instruction (MRI)*, and relevant procurement documents. Eleven reviewed MRRs adequately documented visual receipt inspections of Q and RS weld rods, bulk piping, pipe spools, module assemblies, and associated submittal documents. For example, MRR-22245 for module 9226-TPS-MDL-3843 appropriately included the MRR kick and count report (i.e., the report confirming quantities of materials received), MRI with QCE inspection initials and date, quality verification documents signed by the supplier, weld verification documents, material test reports, certificates of compliance, radiographic test reports, pressure test results, and positive material identification (PMI) results. The MRR also included the material packing list, bill of lading, and BNI-approved supplier deviation requests.

Suspect/counterfeit items (S/CIs) were appropriately documented and processed for reviewed MRIs with required notifications provided in accordance with Y15-95-813, *Suspect/Counterfeit Item Prevention and Detection*. Eleven reviewed MRRs appropriately documented that no S/CIs were identified during the inspection processes.

For reviewed accepted materials, the QCE/FE appropriately marked or tagged the material with the MRR number in accordance with Y17-95-64-847, *UPF Field Material Control and Traceability*. Observed accepted materials in storage areas confirmed that the materials were appropriately marked or tagged with the MRR number. For deficiencies identified after receipt inspection and acceptance, the material was appropriately tagged or documented as a nonconforming material with an NCR initiated in accordance with Y17-95-64-804. Observed warehouse NCR storage areas demonstrated that unsatisfactory or damaged material is appropriately placed in a designated hold or temporary hold area by field procurement material/inventory control personnel until a BNI procurement-system-generated unsatisfactory, overage, shortage, and damaged report is dispositioned by the QCE or until an NCR disposition is provided.

Quality Verification of Installed Piping Systems

Reviewed construction work packages (CWPs) included adequate requirements for quality verification inspections of installed SSCs. Y17-95-64-800, *Construction/Startup Work Control Program*, appropriately defines CWP structure and content to include work scope, briefing/hazards documents, permits/plans, installation drawings, material traceability, and inspection/test records (IRs) for quality verification. Y17-95-64-800 requires preparation of IRs per Y17-95-64-807, *UPF Construction Process for Inspection, Testing, and Inspection Records*, which adequately defines requirements for inspection planning and IR preparation, completion, and review. Reviewed CWPs appropriately included QC verification points, IRs, and required signoffs. For example, while in use in the field, CWP-SABE1CFXXX-P01, *SAB – Level1 – Caustic Filtration*, adequately covered installation and quality verification of system pipes, valves, flanges, hoses, and pipe supports. The work scope adequately identified the applicable TECAM reviews, IRs, and signoffs for QC verification points, and described the installation, welding, and final cleaning/verification of the installed pipes and supports.

Reviewed installed piping and pipe supports appropriately conform to design and quality requirements. Design and QC records for installed CF System QC-inspected RS quality level small bore pipe spool, CF-P-55008-20001-01, and RS quality level pipe support, 9226-01-CF-P-55002-H00005, were comprehensive and demonstrated SSC conformance to design and quality requirements. The records appropriately included the piping isometric drawing, pipe support design drawings, field welding checklists, construction weld maps, the welding procedure/process used, the welder's identification number and performance qualification data, weld filler metal manufacturers' heat and lot codes, positive material identification reports, nondestructive examination (NDE) results, final installed location verification inspection data, MRRs and certified material test reports from receipt inspection of all materials used, and signed-off QC TECAM inspection records. Design attributes appropriately matched the construction details on the design drawings, including pipe/member types, locations/tolerances, lengths, and sizes, weld details, and methods of attachment/connection. Reviewed quality records demonstrated that the examined SSCs were constructed using materials that appropriately conformed to purchase specification and quality requirements, and were designed, inspected, and accepted using the latest revisions of applicable drawings.

The onsite welding programs applicable to Q and RS quality level piping systems effectively ensure that welds meet or exceed specification and quality requirements. The UPF construction welding processes, including work planning, procedures, personnel qualifications, material control, weld execution, inspection and testing, and record-keeping, are properly controlled in accordance with DOE Order 414.1D, attachment 2, criterion 5, and ASME NQA-1, part I, requirement 9. Reviewed welding specifications and procedures complied with ASME requirements for the welding of piping and pressure vessels, and American Welding Society specifications for the welding of structural steel including pipe supports. Reviewed samples of welding QC (i.e., 10 physical and chemical test reports for weld filler materials, 10 welder performance qualification test records, 10 weld QC inspection records for the CF and PK piping systems, associated completed field welding checklists, and weld NDE reports) demonstrated adequate application of site processes to qualify welding processes and welders, procure/control weld filler materials, and inspect/accept completed welds. An observed visual examination of a completed RS quality level pipe-to-flange fillet weld in the MPB was performed in accordance with appropriate specifications and quality requirements by the responsible BNI field welding engineer and QC inspector as required by WR16-26688, *Field Welding Checklist Supplement*.

Piping Acceptance Testing

Observed pneumatic pressure testing for a portion of a completed piping system in the MPB was adequately performed per ASME B31.3 to confirm that it was leak-tight and free of debris. The pre-job briefing thoroughly addressed each work task requirement, and job hazards were appropriately reviewed and controlled. Reviewed test specifications, test procedures, piping drawings, testing apparatus, piping sections, and valve lineups were appropriate to facilitate completion of the test. Test tags designating valve open/closed positions were appropriately attached to valves that were within pressure test boundaries. The calibration stickers for the pressure gauges used during the test confirmed that they were adequately calibrated and traceable to National Institute of Standards and Technology standards in accordance with Y17-95-64-850, *Control of Measuring and Test Equipment*. The observed piping system walkdown, inspection of joints under pressure for leakage, and final air blowdown sequences were appropriately performed in accordance with approved work instructions to demonstrate that the tested portion of the system was leak-free, clean, and acceptable for turnover.

Supplier Surveillance and Audits

Supplier quality representatives (SQRs) appropriately monitored suppliers performing reviewed piping fabrication. Y30-95-802, *Project Supplier Quality*, provides an effective process to verify compliant

implementation of material requisition requirements and applicable QA requirements. Reviewed monitoring activities were adequately documented in periodic quality surveillance reports (QSRs) in accordance with Y30-95-802. SQRs are appropriately qualified in accordance with Y15-95-913, *ASME B31 Owner's Inspector Program*, and documented in CFN-1193, *UPF Owner's Inspector Delegate (OID) Approval Form*. Twenty-four reviewed OID forms demonstrated that inspectors met applicable qualification criteria defined in Y15-95-913.

Four reviewed QSRs demonstrated adequate SQR reviews to verify certified material test reports, material control procedures, material traceability markings, material free of suspect counterfeit indications, PMI procedures and equipment, qualification of PMI personnel, weld procedures, and welder qualifications. These reports also included reviews of weld maps, radiographic reader sheets, weld repairs, and confirmation that critical attributes were verified per TECAM requirements. The reviews appropriately included verification of the current revisions of drawings, confirmation of dimensional checks on fabricated pipe spools, visual inspections of accessible welds for unacceptable surface conditions, visual inspection for internal and external surface cleanliness and finish, test procedure approval, hydrostatic tests, and marking, tagging, appearance, and cleanliness of pipe spools for final inspection for release.

BNI QA personnel appropriately performed reviewed triennial supplier audits of piping fabricators' QAPs and activities to ensure compliance with ASME NQA-1 requirements. One reviewed BNI triennial audit report, SAR-QA-801768-FY22-003, appropriately documented supplier program deficiencies, weaknesses, and observations. Supplier deficiencies were properly documented in CA reports in accordance with Y60-95-822, *BNI QA Supplier Corrective Action*. One reviewed QA surveillance (ISR-QA-801768-FY-04) was appropriately conducted at a piping fabricator's shop to determine the adequacy and effectiveness of the fabricator's welding and inspection program. This surveillance was initiated based on previous delivery of pipe spools that resulted in 13 NCRs due to weld deficiencies. The surveillance was adequately planned according to established review criteria and executed. Results were clearly communicated to the fabricator indicating that they were effectively implementing the quality program and special processes required for pipe spool fabrication, welding, and welding inspection.

Construction Quality Control Conclusions

CNS and BNI have adequately established and implemented a construction quality management system and associated construction QC plan. QCEs and FEs are adequately trained, certified, and qualified to conduct QC verifications. QCEs appropriately conducted verifications of reviewed stored materials, installed piping systems, material and test equipment, and piping acceptance tests. Installed QC-inspected piping and pipe supports conform to design and quality requirements. Onsite welding programs and the QC-inspected welds observed in the field meet or exceed specifications and quality requirements. The pressure testing process for acceptance of constructed piping systems complies with established acceptance and performance criteria in the applicable specifications and ASME code requirements. SQRs have adequately monitored supplier piping fabricators' processes.

3.4 Federal Oversight

This portion of the assessment evaluated the effectiveness of APMO's planning and performance of UPF construction quality oversight activities and management of APMO-identified issues.

Oversight Planning and Performance

APMO processes and procedures for planning and performing Federal oversight of UPF construction quality activities appropriately incorporate the requirements of DOE Order 226.1B. Y12-APMO-PR-

A003, *APMO Oversight Planning Process*, clearly defines oversight planning roles and responsibilities for each level of the organization and provides a systematic, risk-based approach for selecting and prioritizing annual oversight activities based on potential impact to project quality, safety and security, success, cost, and schedule/critical path. The reviewed APMO annual oversight planning guide, *FY 2024 Oversight Planning Guidance Document*, appropriately incorporates Y12-APMO-PR-A003 requirements for specifying mandatory functional area assessment activities and providing planning guidance tailored to anticipated project activities and risks for the upcoming year. Interviewed APMO project leadership, functional area management, and APMO QA staff demonstrated consistent understanding of the oversight planning process and their respective responsibilities.

The APMO FY 2023 integrated assessment plan documented in Y12APMO-PL-A005, *Acquisition and Project Management Office Oversight Plan*, contains an adequate combination of awareness activities, shadow assessments, and formal APMO-led assessments for monitoring both contractor and APMO quality program performance. The plan also appropriately included the FY 2023 annual reviews of contractor and APMO QAPs required by DOE Order 414.1D. Reviewed quarterly report ASM-9.30.2022-6056, *Q3 FY23 Assessment Performance Self-Assessment Report – August 2023*, provided thorough evaluations of scheduled versus completed FY 2023 APMO oversight activities and detailed metrics of recent APMO-identified issues binned by functional area. APMO's establishment of effective formal quarterly Federal oversight activity performance self-assessments that include well-developed metrics supporting trending and analysis of oversight activity timeliness and APMO-identified issues is considered a **Best Practice**.

Y12-APMO-PR-A004, *Y-12 APMO Oversight Execution/Reporting Process*, provides APMO personnel detailed guidance and reference materials to appropriately plan, execute, and report results of APMO awareness activities, shadow assessments, and formal assessments. Reviewed formal APMO assessment reports ASRP-QA-9.29.2020-893820, *UPO Independent Assessment – Implementation of UPF's Quality Assurance Program Description and Contractor Assurance System – October 2020*, ASM-12.8.2-21-5223, *Y-12 APMO Assessment of UPF Welding Program Implementation – June 2021*, ASM-12.8.2021-5222, *Y-12 APMO Assessment of UPF Contractor Assurance System – August 2022*, and awareness activity report ASRP-QA-8.9.2021-921260, *Y-12 APMO Awareness Activity of UPF Welding Nonconformances and Oversight of Suppliers – August 2021*, were conducted by team members with relevant subject matter expertise; incorporated requirements from appropriate orders, procedures, and standards into review criteria; properly categorized identified issues in accordance with Y12-APMO-PR-A004; and provided detailed discussion on the basis for the issues. Additionally, reviewed field notes from APMO shadow assessment and awareness activities related to contractor piping installation QA assessments and supplier piping spool weld defect re-examinations were conducted by knowledgeable APMO personnel, and results were documented in accordance with Y12-APMO-PR-A004.

Federal Issues Management

APMO has appropriately communicated management concerns (MCs) and findings from recent construction quality oversight activities and monitored the development and implementation of associated contractor CAs. Y-12APMO-PR-A001, *APMO Issues Management Process*, provides an adequate process to categorize APMO-identified issues based on impacts to safety and mission, formally communicate APMO oversight activity results to contractors/subcontractors, approve resulting contractor CA plans, and monitor CAs to closure. Reviewed formal memoranda communicating APMO-identified issues generated from ASM-12.8.2021-5222 and ASM-QA-11.17.2021-926481 clearly articulated two MCs to CNS management, identified expectations for associated CA planning, and were appropriately documented in the APMO issues management system Federal Project Directors Project Management Tool (FPD Tool).

Reviewed FPD Tool CA tracking data, APMO and CNS correspondences, APMO functional area lead notes, and closure documentation demonstrated strong APMO engagement with CNS in evaluating the adequacy of CAs generated in response to the two MCs and their effectiveness upon implementation. Interviewed APMO division managers demonstrated strong knowledge of division-specific methodologies for tracking contractor CAs related to APMO-identified issues in their respective functional areas. However, the interviewed division managers also acknowledged challenges with monitoring two different issues management systems (i.e., APMO's FPD Tool and CNS's ActionWay systems) to track the progress of contractor CAs, and varying CA closure approval criteria across APMO divisions. (See **OFI-APMO-1**.)

Federal Oversight Conclusions

Overall, APMO has effectively planned and performed Federal oversight of contractor UPF piping construction quality activities in accordance with DOE Order 226.1B. APMO's formal quarterly self-assessments of its oversight performance that include detailed metrics on oversight activity timeliness and APMO-identified issues is considered a best practice. APMO has appropriately communicated reviewed MCs generated from recent construction quality assessments and monitored associated CA development, execution, and closure through close coordination with CNS. However, challenges were identified with monitoring two different issues management systems to track contractor resolution of APMO-identified issues, and varying criteria across APMO divisions to approve closure of contractor CAs.

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 practice was identified as part of this assessment:

- APMO has effectively established formal quarterly Federal oversight performance self-assessments that include well-developed metrics supporting trending and analysis of oversight activity timeliness and APMO-identified issues.

5.0 FINDINGS

No findings were identified during this assessment.

6.0 DEFICIENCIES

No deficiencies were identified during this assessment.

7.0 OPPORTUNITIES FOR IMPROVEMENT

EA identified the OFI shown below 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.

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OFI-APMO-1: Consider methods to more efficiently track CA data related to APMO-identified issues currently contained in separate APMO and CNS issues management systems and standardizing contractor CA closure approval criteria across APMO divisions. These revised methods may optimize APMO issues management data analysis processes to monitor contractor CAs more effectively and consistently verify their closure.

Appendix A
Supplemental Information

Dates of Assessment

Onsite Assessment: August 28-31, 2023

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