



Assessment of the Maintenance of Structures, Systems, Components, and Programmatic Equipment Providing Nuclear Safety at the Los Alamos National Laboratory

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Acronyms

CFR	Code of Federal Regulations
CMMS	Computerized Maintenance Management System
CSE	Cognizant System Engineer
CY	Calendar Year
DOE	U.S. Department of Energy
EA	Office of Enterprise Assessments
ES-DO	Engineering Services Division Office
FY	Fiscal Year
LANL	Los Alamos National Laboratory
LANS	Los Alamos National Security, LLC
MEL	Master Equipment List
MSS-DO	Maintenance and Site Services Division Office
NA-LA	National Nuclear Security Administration Los Alamos Field Office
NMMP	Nuclear Maintenance Management Program
OFI	Opportunity for Improvement
PF-4	Plutonium Facility
RLWTF	Radiological Liquid Waste Treatment Facility
SBP	Safety Basis Procedure
SC	Safety Class
SS	Safety Significant
SSCs	Structures, Systems, and Components
TA-55	Technical Area 55
Triad	Triad National Security, LLC
USQ	Unreviewed Safety Question
WETF	Weapons Engineering Tritium Facility

Assessment of the Maintenance of Structures, Systems, Components, and Programmatic Equipment Providing Nuclear Safety at the Los Alamos National Laboratory April 29 – May 3 and May 20-24, 2019

Summary

Scope:

In calendar years 2016 and 2017, 45 unplanned system outages prevented the performance of nuclear safety functions at the Los Alamos National Laboratory (LANL) and required operations to be limited to maintain nuclear safety, including 26 outages at the plutonium facilities in Technical Area 55 and the Weapons Engineering Tritium Facility. This assessment evaluated the effectiveness of the LANL nuclear maintenance management program (NMMP) and its implementation in Technical Area 55, the Weapons Engineering Tritium Facility, and the Radiological Liquid Waste Treatment Facility.

Significant Results:

The reviewed structures, systems, components, and programmatic equipment providing nuclear safety in Technical Area 55, the Weapons Engineering Tritium Facility, and the Radiological Liquid Waste Treatment Facility are adequately maintained and maintenance practices are improving.

- In addition to refurbishing and replacing components to restore the nuclear safety functions impacted by the unplanned outages in 2016 and 2017, preventive maintenance requirements were revised to improve system reliability. LANL reported five unplanned outages in calendar year 2018 and one to date in 2019.
- The roles and responsibilities and administrative procedures supporting the NMMP at LANL are comprehensive and well defined. However, this assessment identified weaknesses in the oversight of maintenance of programmatic equipment providing nuclear safety (e.g., gloveboxes providing containment while processing plutonium) and in ensuring that changes in the NMMP continue to support the safety basis of each nuclear facility.
- The NMMP is effectively implemented, with sustained completion rates over 98% for required preventive maintenance, and adequate justification and management of deferred maintenance.

Since 2014, Technical Area 55 facility operations and engineering personnel have been establishing and increasing inventories of spare parts for aged and obsolete equipment to reduce the risk of unplanned system outages impacting pit production. However, they have not developed a comprehensive list of spare parts critical to pit production and, while some funding has been reallocated in 2019, it was not proactively included in the fiscal year 2019 budget, and there is no cost estimate or funding plan to address the needs. The Office of Enterprise Assessments recommends development of a multi-year plan to prioritize the purchase of needed critical spare parts and system upgrades, considering the risk of extended system outages and related impacts on pit production rates projected for Technical Area 55.

No best practices were identified during this assessment.

Follow-up Actions:

No follow-up assessment is planned.

Assessment of the Maintenance of Structures, Systems, Components, and Programmatic Equipment Providing Nuclear Safety at the Los Alamos National Laboratory

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), assessed the maintenance of facility structures, systems, and components (SSCs) and programmatic (process) equipment providing nuclear safety (i.e., SSCs and programmatic equipment that are part of the safety bases for nuclear facilities) at the Los Alamos National Laboratory (LANL). The onsite portions of this assessment were conducted April 29 – May 3 and May 20-24, 2019.

The LANL Plutonium Facility (PF-4), including its support buildings in Technical Area 55 (TA-55), is currently the only plutonium pit production facility in the U.S. The demand for the production of pits at PF-4, currently approximately three per year, is increasing to 10 per year by 2022, and to 30 per year by 2026. This increase in demand emphasizes the need for effective maintenance of SSCs and programmatic equipment (e.g., gloveboxes providing containment while processing plutonium) since unplanned outages can require operations to be limited to maintain nuclear safety.

DOE Order 232.2A, *Occurrence Reporting and Processing of Operations Information*, reporting criterion 4A(1), addresses occurrences where SSC degradation prevents satisfactory performance of an SSC design function when it is required to be operable. This criterion was the basis for more reportable events at LANL in calendar year (CY) 2016 and CY 2017 than any other criterion: 27 out of 96 reportable events in CY 2016 and 18 out of 84 in CY 2017. In CY 2018, the number of events for this criterion was 5 out of 58 events, placing it as the fourth leading criterion, and as of April 18, 2019, there was 1 event for this criterion in CY 2019 (out of 25 events).

This assessment evaluated the effectiveness since January 1, 2016, of the nuclear maintenance management program (NMMP) at LANL, as documented in Procedure P950, *Conduct of Maintenance*, and its implementation in TA-55, the Weapons Engineering Tritium Facility (WETF), and the Radiological Liquid Waste Treatment Facility (RLWTF) for SSCs and programmatic equipment providing nuclear safety.

DOE oversight of the maintenance and operation (M&O) of LANL is provided by the National Nuclear Security Administration Los Alamos Field Office (NA-LA). Los Alamos National Security, LLC (LANS) was the M&O contractor for LANL from June 1, 2006, until October 31, 2018. Triad National Security, LLC (Triad) replaced LANS as the M&O contractor on November 1, 2018. Triad adopted the LANS P950 process with minor administrative changes and retained most of the managers of nuclear maintenance from LANS.

2.0 METHODOLOGY

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

This assessment was conducted in accordance with the *Plan for the Assessment of Nuclear Maintenance Management at the Los Alamos National Laboratory, April – May 2019*. The assessment team reviewed key documents and databases providing system descriptions, work packages, procedures, assessments, metrics, policies, training and qualification records, and lists of SSCs and programmatic equipment providing nuclear safety for the three reviewed facilities. The team also interviewed key personnel responsible for the NMMP, as well as NA-LA managers.

SSCs and programmatic equipment are designated as safety class (SC) or safety significant (SS), in accordance with DOE-STD-3009-94, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses*. SC systems provide nuclear safety functions “to limit radioactive hazardous material exposure to the public,” and SS systems are “a major contributor to defense in depth and/or worker safety.” The assessment team observed ongoing maintenance activities and performed detailed reviews of work packages and post-maintenance test results of the following SSCs and programmatic equipment:

- Oxygen and tritium monitors in WETF (SS systems)*
- Diesel fire water pump in the fire protection system in TA-55 (SC component)*
- Gloveboxes in TA-55 and WETF (SS programmatic equipment)
- Instrument Air System in TA-55 (SS system)
- Facility Control System in TA-55 (SS system).

* The diesel fire water pump in TA-55 and the oxygen and tritium monitors were selected because in CY 2016 and 2017, 10 of the 19 reportable events for TA-55 under criterion 4A(1) were for the fire protection system, and WETF reported 7 events, including 2 for the tritium monitoring system and 3 for the oxygen monitoring system.

Because no RLWTF SSCs or programmatic equipment are designated as SC or SS, the assessment team assessed the overall implementation of the NMMP in RLWTF.

The members of the assessment team, the Quality Review Board, and management responsible for this assessment are listed in Appendix A.

EA has not conducted a recent assessment of the management of nuclear maintenance at LANL, so there were no items for follow-up during this assessment.

3.0 RESULTS

3.1 Nuclear Maintenance Management Program

The objective of this portion of the assessment was to evaluate the Triad NMMP for the following:

- A DOE-approved NMMP with changes approved through the unreviewed safety question (USQ) process is in place and maintained.
- Maintenance organizations and processes with defined roles and responsibilities have sufficient integrated resources to implement the maintenance program.
- A master equipment list (MEL) identifies SSCs and programmatic equipment credited in the safety basis.
- Work control, with cognizant system engineer (CSE) involvement, ensures work planning, scheduling, coordination, and control of maintenance activities/equipment availability.

- Configuration management ensures controlled alignment of safety SSCs with technical basis documents.

Overall, P950 provides a comprehensive NMMP with well-defined roles and responsibilities and detailed administrative procedures managed by the Maintenance and Site Services Division Office (MSS-DO) and the Engineering Services Division Office (ES-DO) to implement the NMMP and P950 requirements. For example, MSS-DO administrative procedures adequately detail the processes for:

- Initiating, updating, and performing preventive and predictive maintenance
- Identifying and reporting the results of facility condition inspections
- Assessing maintenance program performance
- Initiating, screening, planning, performing, and documenting maintenance, including briefly summarizing the history of maintenance performed on each item of SSC and programmatic equipment providing nuclear safety.

ES-DO administrative procedures appropriately include processes for:

- Managing the MEL of credited SSCs and programmatic equipment for each nuclear facility
- Managing the technical reviews of maintenance procedures and system configuration
- Reporting the health of credited SSCs and programmatic equipment
- Requiring testing to validate performance of SSCs and programmatic equipment providing nuclear safety following modifications or maintenance
- Performing independent assessments of vital safety systems.

However, some weaknesses in MSS-DO oversight were identified and are described below and in Section 3.2.

Missed Reviews for Ensuring NMMP Alignment with Safety Bases for Nuclear Facilities

Since January 1, 2016, LANS has submitted and NA-LA approved the fifth and sixth revisions of the LANL NMMP, documented in P950, as required every three years by DOE Order 433.1B, *Maintenance Management Program for DOE Nuclear Facilities*, Change 1. Revision 6, however, was not reviewed in accordance with Safety Basis Procedure (SBP) 112-3, *Unreviewed Safety Question (USQ) Process*, prior to implementation. Attachment 2, paragraph 1.i of DOE Order 433.1B requires USQ reviews of changes to the NMMP “to evaluate whether safety SSCs are maintained and operated within the approved safety basis,” as required by 10 CFR Part 830, *Nuclear Safety Management, Part B-Safety Basis Requirements*. MSS-DO has not adequately overseen implementation of the NMMP to meet the requirement of Attachment 2, paragraph 1.i of DOE Order 433.1B, as discussed below (see **Finding F-Triad-1**):

- Section 5.0 of Revision 5 of P950 set the implementation of Revision 5 for nearly a month after Revision 5 was issued to allow time for USQ determinations to be completed, but MSS-DO did not update Section 5.0 in Revision 6 (i.e., it still stated the implementation date set for Revision 5) and Revision 6 was put into effect upon issuance on May 21, 2018.
- MSS-DO did not know that USQ determinations of Revision 6 had not been performed until the EA assessment team requested documentation of these reviews. A review of Revision 6 per SBP 112-3 for TA-55 was subsequently completed on April 10, 2019. Reviews for RLWTF and WETF were completed over one and two months later on May 14, 2019, and June 18, 2019, respectively.

- MSS-DO did not know and was not determining whether reviews per SBP 112-3 had been completed for the five other LANL nuclear facilities until the EA assessment team requested on May 23, 2019 to see the USQ documentation for these other facilities. MSS-DO subsequently provided these reviews dated June 5-18, 2019, verifying that Revision 6 of P950 supported the safety bases of all nuclear facilities at LANL.
- MSS-DO did not include in P950 the DOE Order 433.1B requirement to perform USQ determinations for changes to the NMMP. (See **Deficiency D-Triad-1.**)
- MSS-DO did not include in P950 the DOE Order 433.1B requirement to submit the NMMP description document (which is P950 at LANL) to the Field Office Manager for approval every three years, but instead states that changes in technical content require approval by the Field Office Manager. (See **Deficiency D-Triad-2.**)

Inadequate Oversight of Maintenance Plans for Programmatic Equipment

MSS-DO is not fulfilling its responsibility per Section 4.1 of P950 to implement and oversee the NMMP with respect to the requirements in P950 for annual maintenance work plans. (See **Deficiency D-Triad-3.**) P950 states that the annual maintenance work plan “establishes a requirements-driven baseline for yearly maintenance work that includes cost, scope, schedule, and resources needed to achieve a maintenance program.”

- Finding 1 of MSS-DO 16-023, *Final Report Submittal for the Conduct of Maintenance Assessment for the TA-55/NPI-3 Programmatic Maintenance*, October 31, 2016, identified that the annual maintenance work plan generated for maintenance on programmatic equipment providing nuclear safety in PF-4 did not include information required by AP-MNT-005, *Annual Maintenance Work Plan*. MSS-DO subsequently issued a revision of AP-MNT-005 providing sponsors of programmatic equipment that is part of the safety basis “the latitude to use...an alternate budget **format** (other than AP-MNT-005). This format must be approved by the programmatic funding source in order to provide funding required for *credited programmatic equipment*, to maintain and defend this equipment at the equipment availability level agreed to by the programmatic funding source sponsors.” The required content of these alternate budget formats is not specified or reviewed by MSS-DO to ensure that the requirements of P950 are met.
- Subsequently, the “alternate budget **format**” (i.e., the work package) used by the Process Equipment Maintenance and Decontamination Services group (NPI-3) to establish the fiscal year (FY) 2019 budget for maintenance of gloveboxes and other programmatic equipment providing nuclear safety in TA-55 was based on the resource requirements in FY 2018 instead of the projected maintenance requirements for FY 2019.

Nuclear Maintenance Management Program Conclusions

P950 provides a comprehensive NMMP with well-defined roles and responsibilities and detailed administrative procedures managed by MSS-DO and ES-DO. Nevertheless, weaknesses exist in MSS-DO oversight of maintenance plans for programmatic equipment providing nuclear safety and in ensuring that changes to the nuclear maintenance program continue to support the safety basis of each nuclear facility.

3.2 Performance Monitoring and Assessments

The objective of this portion of the assessment was to evaluate the implementation of Triad's NMMP for the following:

- Performance monitoring and assessments promote maintenance improvement.
- Maintenance history supports work planning and performance analysis.
- Facility condition inspections monitor facility conditions.
- Inspections evaluate age-related degradation and technical obsolescence.

NMMP Performance Monitoring and Assessments

Per AP-MNT-007, *Measuring, Analyzing, and Reporting of Maintenance Program Performance*, MSS-DO briefs NA-LA on the performance of maintenance using an extensive set of performance measures, goals, and cause codes to identify opportunities to improve maintenance performance. Since January 1, 2016, the completion rate for preventive maintenance exceeded the MSS-DO goal of 98%, except for two months with over 97.2% completion, and the backlog of deferred maintenance was adequately managed. During the monthly program review (briefing) to NA-LA on May 22, 2019, MSS-DO stated, contrary to Section 2.2 of AP-MNT-007, that metrics presented by MSS-DO did not measure or include all maintenance on programmatic equipment that is part of the safety bases for nuclear facilities. (See **Deficiency D-Triad-4.**)

MSS-DO has an independent team of MSS-DO subject matter experts that performs comprehensive and critical assessments of the conduct of maintenance in each nuclear facility. Findings and observations from these assessments are provided to the issue responsible managers for resolution in accordance with LANL P322-4, *Issues Management*, and are reviewed for opportunities to improve performance across LANL (e.g., by revising MSS-DO administrative procedures). MSS-DO assesses the adequacy of corrective actions during its next conduct-of-maintenance assessment, which is typically three years later for nuclear facilities. Consistent with the observations and findings reported in EA's *Assessment of the Management of Nuclear Safety Issues at the Los Alamos National Laboratory* (April 2019), the EA assessment team determined that several of the actions and documentation used to support closure of the findings identified by MSS-DO were inadequate and, in a few cases, irrelevant. MSS-DO's current practice for reviewing the adequacy of corrective actions allows findings that were closed based on inadequate actions or documentation to continue for the next three years without resolution. (See **OFI-Triad-1.**)

Maintenance History

MSS-DO administrative procedures define the process for workers and their supervisors to enter and review brief summaries of maintenance in the Computerized Maintenance Management System (CMMS) and the use of these entries by work planners and engineers to improve future maintenance planning and performance of SSCs and equipment. However, MSS-DO assessments of the conduct of maintenance identified findings in the development and utilization of the LANL maintenance history:

- MSS-DO 16-018, *Final Report Submittal for the Conduct of Maintenance Assessment for the Radiological Liquid Waste Facility*, September 16, 2016, reported that "Maintenance is years behind in uploading maintenance history in to [sic] CMMS" and that maintenance and engineering personnel stated that "Maintenance History is not being used to determine reliability or availability of equipment" or to adjust preventive maintenance periodicities. The EA

assessment team determined that the evidence used to close this finding (i.e., a comparison of the amount of preventive to corrective maintenance) was irrelevant.

- *Conduct of Maintenance Assessment for the Weapons Engineering Tritium Facility (WETF) Programmatic and Facility Equipment*, September 2018, reported that completed work orders and maintenance history are “collected and maintained in the WFO [Weapons Facility Operations Division] Facility server” rather than in CMMS as required by AP-WORK-005, *Work Closeout*. The EA assessment team determined that no evidence showing that maintenance history was being entered into CMMS was provided to close this finding; closure of this finding was based on the statement, “Conducted Briefing with WFO Work planning personnel on the use of maintenance history in the planning process.”

Furthermore, maintenance history briefs continue to not be entered into CMMS or reviewed as required (see **Deficiency D-Triad-5**):

- Contrary to AP-WORK-004, *Work Performance*, since January 1, 2016, maintenance history briefs have been entered for only 15% (8 out of 53) of the closed work orders for maintenance on SC or SS SSCs and programmatic equipment in WETF; 85% (38 out of 45) of the work orders without these briefs were for programmatic equipment. For TA-55, 94% (479 out of 511) of the closed work orders for maintenance on SC or SS SSCs and programmatic equipment had maintenance history briefs in CMMS. The assessment team did not review the maintenance history for RLWTF because it does not have SC or SS SSCs or programmatic equipment.
- Work orders are closed without the maintenance history briefs required by AP-WORK-004, even though AP-WORK-005 requires the Execution Superintendent and the Work Management Center, and AP-WORK-004 requires the responsible engineer (e.g., the CSE), to review the maintenance history for accuracy and completeness.
- Several work control leaders, engineers, planners, and managers referred to scans of completed work orders as sufficient maintenance history, contrary to AP-WORK-004, which states: “The creation of an equipment history brief connects corrective maintenance data to the specific MEL entry associated with the work order task. Capturing this information is vital to a successful maintenance history program, allowing trend analysis to be performed at the equipment level.”
- AP-341-802, *System Health Reporting*, states that the maintenance history in CMMS is a “Primary source of system health data;” however, several CSEs stated that they do not use or access it and instead rely on their informal notes on maintenance performed.

SSC and Programmatic Equipment Performance Monitoring and Assessments

Triad performs comprehensive periodic inspections and evaluations on the condition, age-related degradation, and obsolescence of SSCs and programmatic equipment providing nuclear safety. All SSCs are inspected on a five-year cycle per AP-MNT-004, *Facility Condition Inspections*. For SS and SC SSCs and programmatic equipment, CSEs evaluate system health quarterly per AP-341-802, issuing comprehensive reports on number of hours of availability during the period, the maintenance backlog for the system, any outstanding engineering changes, performance issues, degradation or obsolescence information, and operating trends. AP-341-802 also adequately requires annual reviews of maintenance requirements, potential adverse seismic interactions with adjacent SSCs due to configuration changes or age-related degradation, and reviews of the system health monitoring basis.

Despite these reviews by CSEs, three of the four SSCs reviewed during this assessment in TA-55 (i.e., the diesel fire water pumps, facility control system, and instrument air system) were not replaced before becoming obsolete (because replacement parts for these systems are no longer manufactured). TA-55 engineering and maintenance personnel are mitigating the age-related degradation and obsolescence of these systems by adjusting maintenance requirements and refurbishing old parts (e.g., refurbishing obsolete programmable logic controllers) in parallel with designing replacements for obsolete components.

Comprehensive vital safety system assessments are also periodically performed (every three years for SC SSCs and every five years for SS SSCs and programmatic equipment) by an independent team of engineers per AP-341-901, *Performing Vital Safety System Assessments*. Findings and OFIs identified in 11 of these assessments that were reviewed were appropriately addressed. However, inadequate action has been taken to ensure that expired gloves are replaced before they are no longer able to perform their safety function as a confinement barrier:

- SAR-16-TA55-GB-001, *Vital Safety System Report of Gloveboxes*, Revision 0, dated March 29, 2016, reported that TA-55-AP-039, *Glovebox Glove Integrity Program for TA-55*, poorly defined or did not discuss performance assessment of gloves or what to do with expired gloves. Despite actions taken in response to SAR-16-TA55-GB-001, there is no time limit on how long expired (degraded) gloves can remain installed and part of the active containment system of the glovebox.
- Per Section 6.2.8 of the *TA-55 Technical Safety Requirements*, “Gloveboxes maintain a primary confinement barrier during normal processing operations, in the event of loss of the ventilation system, and during and after a PC-2 seismic event...Glovebox gloves are excluded from the scope of the [in-service inspections] as gloves are inspected prior to first use of the day and many gloves are replaced on a more frequent interval than once every three years.” Gloves placed out of service are no longer inspected despite being in active glovebox systems.

Contrary to the glovebox system performance criteria in the *TA-55 Technical Safety Requirements*, glove management for the TA-55 PF-4 glovebox glove integrity program does not require inspections of expired gloves or limit the time that expired gloves can remain in active glovebox systems. (See **Deficiency D-Triad-6**.)

Performance Monitoring and Assessments Conclusions

Triad performs comprehensive, periodic inspections and evaluations on the condition, age-related degradation, and obsolescence of SSCs and programmatic equipment providing nuclear safety. MSS-DO briefs NA-LA on the performance of maintenance using an extensive set of performance measures, goals, and cause codes to identify opportunities to improve maintenance performance, and performs comprehensive and critical assessments of the implementation of the conduct of maintenance. However, several issues from these MSS-DO assessments were not adequately resolved, including findings that summaries of maintenance activities are not being entered into the CMMS database as required. MSS-DO reporting focuses predominantly on maintenance of SSCs and does not adequately cover maintenance of programmatic equipment providing nuclear safety. The TA-55 PF-4 glovebox glove integrity program does not require inspections of expired gloves or limit the time that expired gloves can remain in active glovebox systems.

3.3 Corrective, Preventive, and Predictive Maintenance

The objective of this portion of the assessment was to evaluate the implementation of Triad's NMMP for the following:

- Appropriate types of maintenance provide for safe, efficient, and reliable operation of safety SSCs and programmatic equipment.
- Maintenance procedures provide appropriate direction of maintenance activities.
- Maintenance is performed per procedures.

AP-MNT-006, *Preventive and Predictive Maintenance*, adequately discusses the use of preventive and predictive maintenance. AP-MNT-006 requires the responsible engineer and the maintenance manager to annually evaluate preventive and predictive maintenance requirements in conjunction with the development of the annual maintenance work plan of AP-MNT-005.

Section 3.1 of AP-MNT-006 is inconsistent with the guidance in DOE Guide 433.1-1A, *Nuclear Facility Maintenance Management Program Guide for Use with DOE O 433.1B*. Specifically, AP-MNT-006 recommends regularly performing maintenance within the "grace period," contrary to the guidance in DOE Guide 433.1-1A to perform maintenance at the nominal periodicity (e.g., weekly, monthly, quarterly) or 25% before or after the nominal periodicity to "allow some flexibility for workload and other unforeseeable conditions." As a good management practice, the TA-55 Facilities Operations Director has directed that preventive maintenance in TA-55 be completed within its nominal periodicity and proactively manages and requests justification for delays beyond the prescribed time.

Predictive maintenance uses vibration analysis to supplement preventive maintenance and improve SSC performance. Although the data for this process is being collected, it is not currently being analyzed due to personnel transfers. TA-55 is retraining a technician to analyze the data and reinvigorate the predictive maintenance program.

For the systems reviewed, maintenance procedures were well developed to support safe and compliant work execution. CSEs are involved in their development and concur on revisions. The scope of planned preventive maintenance is consistent with vendor manual recommendations and operating experience.

The five maintenance activities performed while the assessment team was on site were well-controlled evolutions performed by qualified workers. During the weekly diesel fire water pump surveillance and preventive maintenance, workers appropriately paused work to correct a valve number in the procedure and to get engineering direction for a bend (deformation) in a calibrated dipstick used to measure fuel level.

Deferred maintenance of the SC and SS SSCs and programmatic equipment reviewed was justified as required by AP-MNT-006. The assessment team identified an isolated case of inappropriately deferring a yearly surveillance of the exhaust fans of the RLWTF for four months and then replacing this yearly surveillance with a six-month surveillance of lesser scope.

Corrective, Preventive, and Predictive Maintenance Conclusions

For the systems reviewed, maintenance procedures were well developed to support safe and compliant work execution. The scope of planned preventive maintenance was consistent with vendor manual recommendations and operating experience. The five maintenance activities performed while the assessment team was on site were well-controlled evolutions performed by qualified workers.

3.4 Management of Spare and Replacement Parts

The objective of this portion of the assessment was to evaluate whether parts, materials, and services are procured and made available when required.

Spare and Replacement Parts for RLWTF

Replacement parts for planned maintenance in RLWTF are typically available from the LANL Central Warehouse, so RLWTF does not maintain a local inventory of replacement parts. RLWTF is designed with redundant tanks and components, such as resin beds and filters, which allow RLWTF to continue to receive and/or process water from LANL while changing filters or resin beds or during evacuations for wildland fires. A spare boiler unit stored on site can be installed to replace the operating boiler used to evaporate treated water. The assessment team did not identify any issues with spare and replacement parts at RLWTF.

Spare and Replacement Parts for WETF

WETF maintains an inventory of spare and replacement parts in a Class B storage room, as required by P330-11, *Identification and Control of Items*, adjacent to the maintenance workshop, and some spare tritium monitors are stored in a Class B storage area in the WETF electrical workshop. CSEs have identified the minimum inventory of spare and replacement parts required for their assigned SC and SS SSCs and programmatic equipment. The assessment team examined storage of randomly selected spare parts for the oxygen monitoring system, tritium monitoring system, fire protection system, and gloveboxes and verified that the identified minimum number of parts was stored. The facility also provides controlled storage for calibrated measuring and test equipment.

The MSS-DO *Conduct of Maintenance Assessment for the Weapons Engineering Tritium Facility (WETF) Programmatic and Facility Equipment*, September 2018, identified that the temperature and humidity of the Class B storage at WETF were not being measured as required by P330-11. Subsequently, two instruments providing temperature and humidity data were installed, and the data is recorded manually. The temperature and humidity data recorded in 2019 demonstrates compliance with requirements for a Class B storage facility.

To resolve the issues leading to the reportable, unplanned outages of the oxygen monitoring system in CY 2016 and 2017, the fuel cells are replaced every three months. To resolve the issues with the tritium monitoring system, the failed tritium room monitors were replaced with spare monitors of the same model. However, because this model is obsolete, new tritium room monitors have been purchased and are scheduled to be installed after calibration.

Spare and Replacement Parts for TA-55

Maintaining an inventory of spare and replacement parts for TA-55 is more difficult because:

- TA-55 has more SC and SS SSCs and programmatic equipment. For example, TA-55 has 13 SC systems, whereas WETF has 2 SC systems, and RLWTF has no SC or SS SSCs or programmatic equipment.
- Most of the SC and SS SSCs have been installed since TA-55 commenced operation in 1978. Maintenance of SC and SS SSCs and programmatic equipment is complicated by age-related degradation and technical obsolescence.

The management of replacement parts by the TA-55 Facilities Operations Director and engineering personnel has slowly evolved based on lessons learned from unplanned outages:

- In 2014, replacement glass and gaskets were not available to support ongoing modifications to gloveboxes, since the glass and gaskets previously in storage lacked the required quality assurance documentation and were sent to salvage. Based on lessons learned from this issue, the TA-55 Facilities Operations Director and engineering personnel established minimum and maximum critical spare parts inventories for SC and SS SSCs and programmatic equipment (including new installations), assessed the spare parts inventory relative to the minimum and maximum levels each month, and developed prioritized action plans to resolve differences from the minimum and maximum critical spare part inventories for SC and SS SSCs and programmatic equipment.
- In 2016, the SC diesel fire water pump was out of service for over five weeks because several parts (e.g., engine head and water pump) had degraded and compatible parts were no longer available from the vendor. Actions based on lessons learned from this included evaluating the options for maintaining or replacing other obsolete parts subject to age-related degradation (e.g., relays and sockets in the fire pump controller).
- In 2018, a revision of AP-341-521, *Identification and Control of Critical Spare Parts*, was issued to support these more comprehensive reviews to establish critical spare parts accounting for age-related degradation and obsolescence.
- Within the Triad issues management system, the TA-55 Facilities Operations Director has actions for IM# 2018-541 to identify funding in FY 2019 and FY 2020 for a prioritized subset of the critical spare parts list. Funding to procure critical spare parts was not proactively included in the budget for FY 2019. While the team was onsite, the TA-55 engineering manager stated that replacement part inventories support planned preventive maintenance and that approximately half a million dollars was provided from within the existing FY 2019 budget to procure critical spare parts for unplanned corrective maintenance in TA-55. The TA-55 engineering manager subsequently stated that funding being provided in FY 2019 has increased to one and a half million dollars.
- The TA-55 engineering manager stated that they have been establishing and increasing critical spare part inventories to reduce the risk of unplanned system outages on pit production.

The TA-55 Facilities Operations Director anecdotally stated the total cost for critical spare parts could be from 3 to 13 million dollars; however, neither a comprehensive list of needed critical spare parts nor a cost estimate and funding plan could be provided for the assessment team to validate these estimates or whether the necessary critical spare parts would be procured or whether upgraded systems would be installed in time to support increased plutonium production rates starting in FY 2022. (See **Recommendation R-Triad-1.**)

Management of Spare and Replacement Parts Conclusions

In addition to maintaining an inventory of replacement parts for planned maintenance, facility operations and engineering personnel have been establishing and increasing inventories of spare parts for unplanned corrective maintenance in response to several unplanned outages that were extended due to delays in getting spare parts. Establishment of the minimum inventory of spare parts for TA-55 is still evolving

and lacks a multi-year funding plan coordinated with projects for upgrading TA-55 systems to reduce the risk of extended planned and unplanned system outages and related impacts on plutonium pit production.

3.5 Documentation of Maintenance

The objective of this portion of the assessment was to evaluate the implementation of Triad's NMMP for the following:

- Maintenance personnel are appropriately trained and qualified.
- Equipment used for data collection, inspections, and tests is calibrated and maintained.
- Parts and materials are identified and controlled to ensure proper use.
- Post-maintenance/modification testing is appropriate and approved by the system engineer.
- Post-maintenance testing confirms safety SSC functional performance.

The assessment of maintenance documentation was based predominantly on reviews of closed work packages for maintenance in TA-55 and WETF, since only five maintenance activities were performed while the assessment team was on site. The assessment team did not review work packages in RLWTF because RLWTF has no SC or SS SSCs or programmatic equipment.

Section 3.3.6 of P950 assigns responsibility to the MSS-DO Logistics group for the training and qualification program for maintenance personnel. A spot check of training records of nine individuals identified no training lapses.

AP-341-801, *Post Modification/Post Maintenance Testing*, provides adequate guidance and controls to implement the requirements of P950, Section 3.6.16. Test requirements were clearly specified for the work observed and work packages reviewed, with the exception of the following isolated cases that do not preclude the performance of a nuclear safety function:

- In a work package for maintenance of an air dryer in the SS TA-55 Instrument Air System, the supervisor marked testing as "N/A," and the equipment was returned to service. This is not consistent with AP-341-801, Section 2.2 which states "The engineer must evaluate all equipment maintenance or modification activities which could have affected operability and ensure the tests and inspections are sufficiently thorough to discover maintenance errors as well as demonstrating functional and performance requirements."
- A work package for an unloader valve in the SS TA-55 Instrument Air System specified a test to "verify load/unload operation is correct" but lacked specific criteria to demonstrate the valve met its performance requirements.

AP-WORK-005, *Work Closeout*, provides requirements for documenting maintenance performed, post-modification testing, and entering maintenance history briefs for analysis of equipment performance trends. AP-WORK-005 specifically requires reviews of the work packages by the Execution Superintendent, Maintenance or Area Work Coordinator, and Work Management Center to verify that the documentation required by AP-WORK-005 is included. The 24 work packages for SC and SS SSCs and programmatic equipment reviewed by the assessment team recorded sufficient information to establish evidence of correct completion of the maintenance tasks; however, despite the reviews required by AP-WORK-005, nearly every work package lacked documentation required by AP-WORK-005, or included incomplete documents. (See **Deficiency D-Triad-7**.) For example:

- Signatures were missing for specific training for vital safety systems, authorization from operations to perform glovebox maintenance, verification of materials installed in the TA-55 diesel fire water pumps, and field edits to three work instructions.
- A USQ determination for a maintenance worker qualification standard was attached to work order 578267-01, *PF-8 DAD-1 Deficiencies* instead of a USQ for the work performed.
- Work packages for WETF and TA-55 were marked “information only” rather than “record copy,” indicating that non-controlled work instructions were used for work.
- The serial number and calibration date were not recorded for voltage measurements of the diesel generator starting battery in an SC system for TA-55.
- For several work packages, the post-job review form was not attached, was blank, or was marked “N/A,” including recent work in a TA-55 glovebox resulting in a plutonium uptake.

Documentation of Maintenance Conclusions

The reviewed documentation for maintenance performed on SC and SS SSCs and programmatic equipment recorded sufficient information to establish evidence of completion of the maintenance tasks, and the test results for the reviewed packages confirmed that nuclear safety functions were restored. However, nearly all of these work packages lacked some documentation, or included incomplete documents.

4.0 BEST PRACTICES

No best practices were identified during this assessment.

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 226.1, *Implementation of Department of Energy Oversight Policy*, to manage the corrective actions and track them to completion.

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Finding F-Triad-1: MSS-DO has not adequately overseen implementation of the NMMP to ensure that changes to the NMMP are reviewed in accordance with the Triad USQ process as required by DOE Order 433.1B. (P950, Section 4.1)

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.

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Deficiency D-Triad-1: MSS-DO did not include in P950 the requirement to perform USQ determinations for changes to the NMMP. (DOE Order 433.1B, Attachment 2, paragraph 1.i)

Deficiency D-Triad-2: MSS-DO did not include in P950 the requirement to submit the NMMP description to the Field Office Manager for approval every three years. (DOE Order 433.1B, Attachment 2, Paragraph 1.e)

Deficiency D-Triad-3: MSS-DO is not fulfilling its responsibility per P950 to implement and oversee the NMMP with respect to the requirements in P950 for annual maintenance work plans for programmatic equipment providing nuclear safety. (P950, Section 4.1)

Deficiency D-Triad-4: Contrary to AP-MNT-007, MSS-DO does not comprehensively report the performance of maintenance on programmatic equipment that is part of the safety bases for nuclear facilities. (AP-MNT-007, Section 2.2)

Deficiency D-Triad-5: In many cases, maintenance history briefs are not:

- Entered into CMMS (AP-WORK-004, Section 5.3, Step 45)
- Reviewed for accuracy and completeness by the responsible engineer (AP-WORK-004, Section 5.3, Step 42)
- Verified by the Execution Superintendent and the Work Management Center (AP-WORK-005, Step 1 of Section 5.1, and Step 2 of Section 5.2, respectively)
- Reviewed for system health reporting (AP-341-802, Section 3.4.3).

Previous actions to resolve these issues individually have not been effective, so these are listed together in this report to encourage a coordinated and integrated approach for resolving them.

Deficiency D-Triad-6: Contrary to the glovebox system performance criteria in the *TA-55 Technical Safety Requirements*, the TA-55 Facility Operations Director's glovebox glove integrity program does not require inspections of expired gloves or limit the time that expired gloves can remain in active glovebox systems. (*TA-55 Technical Safety Requirements*, Section 6.2.8)

Deficiency D-Triad-7: Reviews of completed work packages by Execution Superintendents and the Work Management Centers do not verify that documents are appropriately filled out or appropriately marked "N/A." (AP-WORK-005, Section 5.1, Step 1 and Section 5.2, Step 1)

7.0 RECOMMENDATIONS

EA identified one recommendation for consideration by senior line management. Recommendations do not require formal resolution through a corrective action process and are not intended to be prescriptive or mandatory. Rather, they are suggestions derived from the aggregate results of an assessment that may assist senior line management in improving the effectiveness of programs or site management.

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Recommendation R-Triad-1: Triad should establish a multi-year plan to prioritize the purchase of needed critical spare parts and system upgrades considering the risk of extended planned and unplanned system outages and associated impact on pit production rates projected for TA-55.

8.0 OPPORTUNITIES FOR IMPROVEMENT

The assessment team identified one OFI for consideration by cognizant managers. 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. OFIs do not require formal resolution by management through a corrective action process and are not intended to be prescriptive or mandatory. Rather, they are suggestions for implementing best practices or provide potential solutions to issues identified during the assessment.

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OFI-Triad-1: MSS-DO should consider following up on findings and deficiencies it identifies during conduct-of-maintenance assessments in a timely manner (e.g., when the corrective action plan has been established and/or when the issue has been closed in Triad's issues management system).

Appendix A Supplemental Information

Dates of Assessment

Onsite Assessment: April 29 – May 3, 2019 and May 20-24, 2019

Office of Enterprise Assessments (EA) Management

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