# Conduct of Maintenance Assessment at Sandia National Laboratories/New Mexico

**December 2019**

Office of Enterprise Assessments
U.S. Department of Energy

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## Acronyms

| | |
|---|---|
| ACRR | Annular Core Research Reactor |
| AHCF | Auxiliary Hot Cell Facility |
| CRAD | Criteria and Review Approach Document |
| CSE | Cognizant System Engineer |
| DOE | U.S. Department of Energy |
| EA | Office of Enterprise Assessments |
| eB | Enterprise Bridge |
| MEL | Master Equipment List |
| NMMP | Nuclear Maintenance Management Program |
| NTESS | National Technology and Engineering Solutions of Sandia, LLC |
| OAA | Operational Awareness Activity |
| OFI | Opportunity for Improvement |
| PPS | Plant Protection System |
| SFO | Sandia Field Office |
| SNL/NM | Sandia National Laboratories/New Mexico |
| SSC | Structure, System, and Component |
| TA-V | Technical Area V |
| TSR | Technical Safety Requirements Document |

# Conduct of Maintenance Assessment
# at Sandia National Laboratories/New Mexico
# May 6-9, 2019

## Summary


**Scope:**
This assessment evaluated conduct of maintenance at Sandia National Laboratories/New Mexico Technical Area V (TA-V) by the site contractor, National Technology and Engineering Solutions of Sandia, LLC (NTESS). The National Nuclear Security Administration's Sandia Field Office requested that the Office of Enterprise Assessments assess the implementation of four elements of NTESS's nuclear maintenance management program (NMMP) among the 17 required by U.S. Department of Energy (DOE) Order 433.1B, *Maintenance Management Program for DOE Nuclear Facilities*: the master equipment list, procedures, maintenance history, and performance measures. In addition, this assessment evaluated whether NTESS is conducting self-assessments of the NMMP as required by the DOE order.

**Significant Results for Key Areas of Interest:**
Overall, NTESS adequately implements the four reviewed NMMP elements. However, NTESS has not conducted a self-assessment of the NMMP within the past three years, contrary to DOE Order 433.1B.

Master Equipment List
NTESS is effectively managing and maintaining a TA-V master equipment list that clearly identifies structures, systems, and components (SSCs) addressed in the Annular Core Research Reactor and Auxiliary Hot Cell Facility safety basis documentation.

Procedures
NTESS's maintenance procedures are mostly adequate. However, some Annular Core Research Reactor maintenance procedures are not consistent with the NTESS *Technical Writers Procedure.*

Maintenance History
Cognizant system engineers (CSEs) are effective in retrieving safety SSC maintenance records from a variety of locations and organizations, and assessing/analyzing these records to monitor performance.

Performance Measures
Performance measures provide comprehensive and mostly accurate information to identify areas requiring management attention. CSEs effectively use performance data to make maintenance decisions and process improvements.

Best Practices and Findings
There were no Best Practices identified as part of this assessment.

There were no findings identified as part of this assessment.

**Follow-up Actions:**
No follow-up activities are planned.

**Conduct of Maintenance Assessment**
**at Sandia National Laboratories/New Mexico**

## 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), performed an assessment of the conduct of maintenance at Sandia National Laboratories/New Mexico's (SNL/NM's) Technical Area V (TA-V). The purpose of this assessment was to evaluate the effectiveness of the implementation of maintenance processes and programs by the site contractor, National Technology and Engineering Solutions of Sandia, LLC (NTESS). The assessment team performed the onsite portion of this assessment May 6-9, 2019.

The National Nuclear Security Administration's Sandia Field Office (SFO) requested that EA assess the implementation of four elements of NTESS's nuclear maintenance management program (NMMP) among the 17 required by DOE Order 433.1B, Change 1, *Maintenance Management Program for DOE Nuclear Facilities*: the master equipment list (MEL), procedures, maintenance history, and performance measures. In addition, this assessment evaluated whether NTESS is conducting self-assessments of the NMMP as required by the DOE order. The assessment team developed the assessment scope in cooperation with the SFO Assistant Manager for Engineering, as documented in the *Plan for the Office of Enterprise Assessments Assessment of Conduct of Maintenance at the Sandia National Laboratories/New Mexico Site, April – May 2019*.

TA-V is a remote research area where the Annular Core Research Reactor (ACRR), the Sandia Pulsed Reactor Facility – Critical Experiments, the Gamma Irradiation Facility, and the Auxiliary Hot Cell Facility (AHCF) are located. Although the NMMP supports nuclear maintenance activities at all of these facilities, the assessment team's main focus was on the Hazard Category 2 ACRR and the Hazard Category 3 AHCF facilities, which are the higher hazard nuclear facilities at TA-V.

## 2.0 METHODOLOGY

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

As identified in the assessment plan, this assessment considered requirements related to DOE Order 433.1B. Table 1 lists the NMMP implementation elements reviewed, along with the associated objectives from Criteria and Review Approach Document (CRAD) 30-06, Rev. 0, *Conduct of Maintenance*.

**Table 1. NMMP Implementation Elements and Associated CRAD 30-06 Objectives**

| DOE Order 433.1B NMMP Implementation Elements | CRAD 30-06 Objective Number |
|---|---|
| Master Equipment List | MT.3 |
| Maintenance Procedures | MT.6 |
| Maintenance History | MT.12 |
| Performance Measures | MT.15 |

The assessment team examined documents, such as the documented safety analysis, system descriptions, maintenance procedures, work packages, and policies. Additionally, the assessment team interviewed personnel responsible for developing and executing the NMMP and inspected significant portions of selected TA-V facilities, focusing on maintenance activities. 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 TA-V facilities. Therefore, there were no items for follow-up during this assessment.

## 3.0 RESULTS

Overall, NTESS adequately implements the four reviewed NMMP elements. NTESS is effectively managing and maintaining a TA-V MEL that identifies the structures, systems, and components (SSCs) within the ACRR and AHCF safety bases. NTESS's maintenance procedures are mostly adequate with some exceptions noted in Section 3.2 below. TA-V's maintenance history is well documented and retrievable by cognizant system engineers (CSEs), who have learned the locations of the various maintenance records generated by different TA-V and supporting organizations. NTESS adequately develops, maintains, analyzes, communicates, and uses performance measures to identify safety-related maintenance issues requiring corrective action and lessons learned with one exception noted in Section 3.4 below. TA-V personnel, under the former SNL/NM contractor, assessed the 17 elements of the NMMP in 2015 but did not provide the NMMP self-assessment to the assessment team for review. Since that time, NTESS has not conducted NMMP self-assessments within the minimum three-year frequency required by DOE Order 433.1B, Attachment 2, Section 1.g. (See **Deficiency D-NTESS-1**.) Because the required periodic self-assessment is overdue, NTESS missed the opportunity to promptly identify and resolve performance and programmatic weaknesses.

### 3.1 Master Equipment List

The objective of this portion of the assessment was to verify that NTESS is implementing, managing, and maintaining the MEL at a level that clearly identifies the SSCs addressed in the ACRR and AHCF safety bases.

CSEs adequately maintain their configuration management database, Enterprise Bridge (eB), which aggregates appropriate information related to safety SSCs. The CSEs effectively use the eB to generate the MEL, which appropriately includes all of the SSCs within the ACRR and AHCF safety bases.

The TA-V NMMP appropriately specifies the types of maintenance categories (corrective, preventive, and surveillance) for safety SSCs, which are consistent with DOE Order 433.1B. The assessment team's review of 17 TA-V safety system maintenance records indicated that NTESS performed the appropriate SSC maintenance. However, except for the ACRR Plant Protection System (PPS), CSEs recorded MEL maintenance category entries as "corrective, surveillance" for many of the SSCs listed in the MEL, even though they do not have an associated surveillance identified in the technical safety requirements document (TSR). These designations cause confusion regarding the type of maintenance performance expected.

A crosswalk of the MEL and spare parts database shows clear linkage with SSCs. This practice effectively implements guidance from DOE Guide 433.1-1A, *Nuclear Facility Maintenance Management Program Guide for Use with DOE O 433.1B*, Section III C.2. Furthermore, this provides NTESS with a useful link between critical spare parts and SSCs that are part of the ACRR and AHCF safety bases as required by DOE Order 433.1B, Attachment 2, Section 1.a. In 2016, the former SNL/NM contractor

conducted a self-assessment of critical spare parts for the TA-V facilities and concluded that only the ACRR needs to store critical spare parts. A field verification performed by the assessment team showed that the storage, segregation, labeling, and control for five critical spare parts identified in the ACRR MEL were adequate. However, the inventory process and listing for critical spares lack the level of detail recommended by DOE Guide 433.1-1A (e.g., minimum stock levels, manufacturer name, part numbers, shelf life, and guidance for programmatic upkeep).

**Master Equipment List Conclusions**

TA-V has an established MEL that lists all of the SSCs within the ACRR and AHCF safety basis. NTESS adequately develops, approves, and maintains the TA-V MEL. The TA-V NMMP appropriately specifies the types of maintenance categories for safety SSCs. For many of the SSCs listed in the MEL, the CSEs recorded the maintenance category as "corrective, surveillance," even though these SSCs do not have an associated surveillance identified in the TSR.

## 3.2 Procedures

The objective of this portion of the assessment was to verify that NTESS maintenance procedures for the ACRR and the AHCF provide appropriate direction for maintenance activities to ensure that work is performed safely and in accordance with technical standards, administrative controls, and facility-identified hazard controls.

NTESS has a computer-based ACRR control room simulator, which was initially developed as part of the ACRR control system upgrade. The simulator mimics both reactor control and remotely operated safety systems. The CSEs at the ACRR have expanded the simulator's use to support the development of maintenance procedures. Using the simulator, NTESS demonstrated to the assessment team how maintenance procedure implementation is assessed to identify potential challenges and verify expected results of certain steps and sequences, providing confidence that the procedure can be implemented as written. The assessment team observed that the use of the simulator has resulted in CSEs and other maintenance personnel becoming more engaged in maintenance procedure development and better prepared to implement maintenance procedures in the field.

Maintenance procedures reviewed with facility supervisors and CSEs are mostly adequate. Procedures reviewed included 11 for the ACRR and 1 for the ACHF. The reviews consisted of three corrective maintenance, six preventive maintenance, and three surveillance procedures (one ACHF). Of those, two were observed being performed, four were completed procedures with recorded results (one ACHF), and six were procedures with no recorded results. The procedures for the ACRR PPS were well written with sufficient detail and direction for an operator to perform a maintenance activity. However, 10 of the 12 procedures reviewed contained examples that were not consistent with the NTESS *Technical Writers Procedure* as they contained one or more of the following: multiple steps in one step, steps embedded in notes and cautions, steps that do not provide explicit directions for completing a task, no guidance for addressing issues with the data collected from a maintenance activity, and/or no guidance for documenting names and dates of completing the maintenance activity. Also, some procedures contained steps that were not designated as "critical steps" even though these steps met the *Technical Writers Procedure's* critical step definition. Critical steps involve technical safety requirements or safety significant systems and thus indicate a need for increased attention and verification. As a result, NTESS is missing the opportunity to heighten worker attention to critical steps intended to prevent consequential errors.

The two most recently completed nuclear instrumentation channel calibrations, using procedure ACRR-MP-002, *Power Determination by Pool Heat Up,* were adequate. However, in a 2018 calibration

performance, NTESS did not assess an out-of-calibration condition for past nuclear instrumentation operability because the procedure does not provide direction to address "as-found" settings that are out-of-calibration. Also, the reviewed calibration records indicated that NTESS made a slight channel adjustment in 2017 and again in 2018 to normalize power indication, without analyzing the cause of the power indication drift. This occurred because there is no established drift monitoring procedure to address such a condition. Monitoring the drift of channels between calibrations would identify needed compensatory actions (adjusting "as-left" tolerances or increased/decreased calibration frequencies) to ensure that channels remain within specification between calibrations. (See **OFI-NTESS-1**.)

The reviewed AHCF safety significant process ventilation system test performance records were adequate. However, the assessment team's field inspections of the AHCF process ventilation system and field verification of the system test procedure indicated that the system was missing sample point labels identified in the procedure. Also, other labels did not agree with procedure nomenclature, contrary to the requirements of the *NTESS Component Labeling* procedure. During a field inspection, the CSE could not correlate key procedure test performance locations (e.g., test aerosol injection and sampling points) with field labeling.

The NTESS Operational Awareness Activity (OAA) program is intended to encourage management observations of ongoing work activities, performance feedback to workers, and mentoring/relationship building opportunities. OAAs performed by NTESS management over the past three years generally did not provide meaningful feedback to improve worker performance or maintenance procedures. Furthermore, NTESS managers performed a very limited number of OAAs during the annual planned ACRR maintenance. Scheduling OAAs during high maintenance periods and focusing on providing worker performance feedback increases the opportunities to develop lessons learned that will reduce errors and improve work quality. (See **OFI-NTESS-2**.)

**Procedures Conclusions**

NTESS's use of the computer-based ACRR control room simulator resulted in CSEs and other maintenance personnel becoming more engaged in maintenance procedure development and better prepared to implement maintenance procedures in the field. NTESS's maintenance procedures are mostly adequate. However, some ACRR procedures are not consistent with the NTESS *Technical Writers Procedure.* While nuclear instrumentation channel calibrations are adequate, NTESS does not monitor the drift of channels between calibrations to identify needed compensatory actions. NTESS managers seldom perform OAAs during periods of high maintenance, and OAA reports generally lack documented feedback, limiting opportunities for lessons learned and improved performance.

### 3.3 Maintenance History

The objective of this portion of the assessment was to ensure that maintenance history records support maintenance work performance and safety SSC performance analysis.

The TA-V CSEs are knowledgeable of their assigned system performance and maintenance procedures, and are effective in retrieving and assessing/analyzing each safety SSC's history of maintenance to generate system health reports.

NTESS creates maintenance records that it retains in various locations. The TA-V work order history for the period of January 1, 2018, to May 7, 2019, was obtained from Maximo, which is NTESS's institutional computer maintenance management system. The assessment team reviewed 30 corrective maintenance records, 25 preventive maintenance records, and 17 surveillance records to determine if the maintenance history records were complete and included data sheets, log entries, and signatures.

Of those, one AHCF surveillance maintenance record was found to be incomplete and was missing resultant data from the performed surveillance. After this issue was brought to the CSEs' attention, the surveillance data was obtained from the offsite subcontractor who completed the work activity for subsequent entry into the Maximo system. The remainder of the records reviewed were in accordance with NTESS maintenance history record requirements.

TA-V narrative logs (electronic) are another source of ACRR and AHCF maintenance records, which may be used by TA-V staff for documenting maintenance-related information or events. Sixty narrative log entries were reviewed, and all were determined to contain valuable information that the CSEs could use for generating reports that discuss system performance at a given facility (e.g., ACRR PPS health report). Although TA-V's maintenance records were distributed in several different, non-centralized locations with no formal process established for maintenance history record retention, the CSEs were able to demonstrate that they knew where the records were located and were effectively retrieving them for system health reports.

**Maintenance History Conclusions**

Overall, TA-V's maintenance history is well documented and retrievable by the CSEs, who have learned the locations of the various maintenance records generated by different TA-V and supporting organizations. However, no formal description exists of the variety of maintenance history record retention locations. The CSEs' ability to obtain complete maintenance history records is based on their expert knowledge of where to look. This approach can result in maintenance histories that are difficult to retrieve for less experienced CSEs.

### 3.4 Performance Measures

The objective of this portion of the assessment was to verify that NTESS develops, maintains, analyzes, and communicates performance measures to identify safety-related maintenance issues requiring corrective action and lessons learned.

The TA-V suite of performance measures provides comprehensive and mostly accurate maintenance performance information (with one exception as addressed below). NTESS recently examined performance activities for potential measurement improvement in its 2018 ACRR control system upgrade failure modes and effects analysis that appropriately identified new measures (e.g., TSR-controlled pool water parameters for trending of measurement stability between annual calibrations). NTESS adequately calibrates ACRR sensors used to measure these safety significant SSC parameters, consistent with TSR limiting conditions for operation.

CSEs adequately use performance measurement data to make maintenance decisions; make facility improvements; analyze adverse performance data for causes; and develop, implement, and validate appropriate corrective actions to address undesirable performance measure trends. For example:

- In response to trending data since 2006 for an ACRR pulse energy/power cadmium detector that exhibited an adverse trend in late 2015, CSEs identified the need to locate a vendor, characterize spare detectors, and install/test spare detectors. Due to the cost and long lead time involved in procuring replacement detectors, NTESS performed two special calibrations extending the service life of the detectors, recognizing that these recalibrations reduced the upper operating range of the ACRR. NTESS has recently issued a purchase order to replace the detectors.

- Anomalies in the AHCF fume hood exhaust flow trend data from 2019 Quarter 1 resulted in identification of problems with the fume hood pneumatic valve controller and subsequent testing, evaluation, and replacement of the valve.

CSEs effectively communicate performance measures through system health reports that provide adequate information and trending perspectives on safety system operability, reliability, and material condition, consistent with DOE Order 420.1C, *Facility Safety*, Chapter V. NTESS sends a quarterly *TA-V Performance Metrics* report to SFO and all TA-V organizations addressing 28 metrics related to engineering, operations, and maintenance.

There was no issue with TSR-required surveillance performance timeliness. However, the metrics data for "percent of preventative maintenance activities and surveillances completed as scheduled" does not include the data from TSR-required surveillances (as defined in the report's Performance Measure Data Dictionary) but instead, only included non-TSR surveillance data. The CSE agreed that this metric data was inaccurate and committed to resolving this issue. Interviewees indicated that NTESS has not performed a validation of the metric inputs within the past two years.

**Performance Measures Conclusions**

NTESS adequately develops, maintains, analyzes, communicates, and uses performance measures to identify safety-related maintenance issues requiring corrective action and lessons learned, with one exception. While there was no issue with TSR-required surveillance performance timeliness, the metrics data for "percent of preventative maintenance activities and surveillances completed as scheduled" does not include the data from TSR-required surveillances.

## 4.0 BEST PRACTICES

There were no best practices identified as part of this assessment.

## 5.0 FINDINGS

There were no findings identified as part of this assessment.

## 6.0 DEFICIENCIES

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

This deficiency applies to NTESS.

**Deficiency D-NTESS-1**: NTESS has not completed a self-assessment of the NMMP within the three-year periodic review requirement. (DOE Order 433.1B, Attachment 2, Section 1.g)

## 7.0 OPPORTUNITIES FOR IMPROVEMENT

The assessment team identified two OFIs 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. These OFIs are offered only as recommendations for line management consideration; they do not require formal resolution by management through a corrective action process and are not intended to be prescriptive or mandatory. Rather, they are suggestions that may assist site management in implementing best practices or provide potential solutions to issues identified during the assessment.

The OFIs apply to NTESS.

**OFI-NTESS-1**: Consider establishing a drift-monitoring program to assess the performance of analog systems over time. If a channel is found to drift between calibrations, then tracking the amount of that drift would provide the opportunity to determine whether the channel would be out of calibration before the next performance of the calibration, and whether the calibration frequency is adequate to prevent the out-of-specification condition. Also, as part of the channel calibration process, consider establishing a requirement to determine whether a channel would have performed its design function given its as-found condition.

**OFI-NTESS-2**: Consider conducting OAAs during periods of high maintenance and focusing observations on providing performance feedback and coaching to workers. Feedback that reinforces the organization's standards for procedure use, a questioning attitude, and industrial safety would support continuous improvement.

## Appendix A
## Supplemental Information

**Dates of Assessment**

Onsite Assessment: May 6-9, 2019

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