Independent Assessment of Safety System Management at the Sandia National Laboratories – New Mexico Annular Core Research Reactor Facility

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Office of Enterprise Assessments
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Acronyms

ACRR	Annular Core Research Reactor Facility
AME	Assistant Manager for Engineering
ANS	American Nuclear Society
ANSI	American National Standards Institute
CA	Corrective Action
CAS	Contractor Assurance System
CFR	Code of Federal Regulations
CGD	Commercial Grade Dedication
CM	Configuration Management
CR	Condition Report
CRAD	Criteria and Review Approach Document
CSE	Cognizant System Engineer
DCR	Document Change Request
DLMP	Document Lifecycle Management Procedure
DOE	U.S. Department of Energy
EA	Office of Enterprise Assessments
FR	Facility Representative
FY	Fiscal Year
KPI	Key Performance Indicator
M&TE	Measuring and Test Equipment
NNSA	National Nuclear Security Administration
NQA	Nuclear Quality Assurance
NTESS	National Technology and Engineering Solutions of Sandia, LLC
OAA	Operational Awareness Activity
OFI	Opportunity for Improvement
PPS	Plant Protection System
QA	Quality Assurance
QAP	Quality Assurance Program
RSS	Reactor Safety System
SDD	System Design Description
SFO	Sandia Field Office
SHR	System Health Report
SNL-NM	Sandia National Laboratories – New Mexico
SR	Surveillance Requirement
SS	Safety Significant
SSCs	Structures, Systems, and Components
TA-V	Technical Area V
TSR	Technical Safety Requirement
TRW	Transient Rod Withdrawal
USQ	Unreviewed Safety Question
WRS	Wide Range System

INDEPENDENT ASSESSMENT OF SAFETY SYSTEM MANAGEMENT AT THE SANDIA NATIONAL LABORATORIES – NEW MEXICO ANNULAR CORE RESEARCH REACTOR FACILITY

Executive Summary

The U.S. Department of Energy (DOE) Office of Enterprise Assessments (EA) conducted an independent assessment of safety system management implemented by National Technology and Engineering Solutions of Sandia, LLC (NTESS) at Sandia National Laboratories – New Mexico in May and June 2023. The assessment focused on safety-significant structures, systems, and components at the Annular Core Research Reactor facility (ACRR) and included a review of contractor safety management programs and Federal oversight provided by the National Nuclear Security Administration Sandia Field Office (SFO).

EA identified the following strengths:

- NTESS has established an effective process for training and qualifying lead auditors that requires participation in five audits, including one nuclear quality assurance audit, within the year prior to completing their initial qualification.
- NTESS has established an effective engineering management program and appropriate implementing procedures to meet the requirements of American Society of Mechanical Engineers consensus standard Nuclear Quality Assurance (NQA)-1-2017, *Quality Assurance Requirements for Nuclear Facility Applications*.
- NTESS completed an effective internal audit of the ACRR implementation of the NQA-1-2017 program and self-identified findings and opportunities for improvement. Corrective actions have been appropriately initiated to address these findings.
- SFO performs routine field walkdowns , closely engages with NTESS, and conducts formal assessments to ensure effective Federal oversight of NTESS activities at the ACRR.

EA also identified several weaknesses, including one finding, as summarized below:

- NTESS has not established training and qualification requirements for personnel engaged in quality control inspections. (Finding)
- In some instances, NTESS did not adhere to procedural requirements. Examples were identified in the areas of engineering calculations, equipment labeling, change control, system health reports, and surveillance and testing.
- Some NTESS surveillance procedures are not all correctly categorized as “continuous use” procedures.
- Some NTESS procedures contain inaccuracies and conflicting requirements.
- The NTESS assurance management program procedure does not address timely reporting and completion of corrective actions for deficiencies, other than those categorized as events.

In summary, NTESS has established the essential safety system management programs necessary for managing and maintaining SS SSCs at the ACRR. Also, SFO is meeting the requirements of DOE Order 226.1B, *Implementation of Department of Energy Oversight Policy*, and has implemented an adequate safety system oversight program. However, identified weaknesses in safety system management programs and their implementation reduce the confidence that intended safety functions can be performed. Until the weaknesses identified in this report are addressed or effective mitigations are put in place, uncertainties will exist regarding the impacts of weaknesses on the safety of ongoing nuclear operations at Sandia National Laboratories – New Mexico facilities.

INDEPENDENT ASSESSMENT OF SAFETY SYSTEM MANAGEMENT AT THE SANDIA NATIONAL LABORATORIES – NEW MEXICO ANNULAR CORE RESEARCH REACTOR 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), assessed the effectiveness of safety system management at the Sandia National Laboratories – New Mexico (SNL-NM) Annular Core Research Reactor facility (ACRR). The onsite portion of the assessment was conducted May 1-5 and June 5-9, 2023.

The ACRR is a hazard category 2 pool-type research reactor (Category B) that is capable of steady-state, pulse, and tailored-transient operation. The ACRR is used primarily for testing electronics and for reactor safety research. The ACRR is located in Technical Area V (TA-V) at SNL-NM and is operated by National Technology and Engineering Solutions of Sandia, LLC (NTESS), a prime contractor of the National Nuclear Security Administration (NNSA). The NNSA Sandia Field Office (SFO) is responsible for oversight of NTESS. This assessment also evaluated the effectiveness of SFO's oversight of NTESS safety system management.

Consistent with the *Plan for the Independent Assessment of Safety System Management at the Sandia National Laboratory Annular Core Research Reactor Facility, May 2023*, this assessment evaluated the effectiveness of NTESS's programs and processes for engineering design, configuration management (CM), cognizant system engineering, safety system surveillance and testing, quality assurance (QA), and feedback and improvement. The ACRR has no safety class controls and the active SSCs are functionally classified as safety significant. The ACRR systems within the scope of this assessment included the reactor safety system (RSS) and the ACRR pool water level monitoring system. The RSS comprises four active engineered safety systems: the reactivity control system, instrumentation and control, the plant protection system (PPS), and the wide range system (WRS).

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, this assessment considered requirements related to the management of safety systems. Further, EA examined the flowdown of safety basis requirements into technical baseline documents and the application of appropriate technical requirements in the procurement process for critical spare parts and replacement items. EA used Criteria and Review Approach Document (CRAD) 30-11, Rev. 0, *Safety Systems Management Review*. Criteria used to guide this assessment was based on selected objectives and criteria from within sections SS.1. SS.2. SS.3, SS.5, SS.7, and SS.8 of EA CRAD 30-11. In addition, EA selected objectives and criteria from section FO.2 elements of EA CRAD 30-07, Rev. 0, *Federal Line Management Oversight Processes*, to collect and analyze data on SFO oversight activities. EA also examined key documents, such as system design descriptions (SDDs), system health reports (SHRs), work orders, procedures, engineering analyses, design change packages, and training and qualification records. Furthermore, EA interviewed key personnel responsible for developing and executing the associated programs; observed daily activities related to operations and surveillance and

testing; and performed onsite inspections of accessible portions of the selected systems. EA also conducted interviews and reviewed assessment records to determine whether the Federal oversight program ensures that safety systems reliably perform to meet their safety function. 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 NTESS's engineering management program, and design verification and documentation, to confirm that engineering design documents and analyses are technically adequate, implement sound engineering principles and incorporate applicable safety design bases such that adequate protection of the public, the workers, and the environment from facility hazards is demonstrated.

Engineering Design Program

NTESS has established a generally adequate engineering design program. NTESS effectively established *TA-V Engineering Management Program Description*, dated 11/02/2022, which defines clear roles and responsibilities, and engineering procedures that adhere to requirements in American Society of Mechanical Engineers consensus standard Nuclear Quality Assurance (NQA)-1-2017, *Quality Assurance Requirements for Nuclear Facility Applications* (NQA-1) and support the continued safe operation of nuclear facilities at TA-V, including ACRR. Primary program roles appropriately include systems engineering, engineering design, and CM. The program provides an adequate process for developing and controlling design criteria, performing calculations, and developing drawings. The requirements in *TA-V Engineering Management Program Description* are adequate to ensure that engineered safety significant (SS) structures, systems, and components (SSCs) and processes are designed using sound engineering and scientific principles. The program also provides an adequate process to ensure the translation of design bases and assumptions identified in the safety analysis into criteria for design outputs (e.g., calculations, drawings, and procedures). *TA-V Engineering Management Program Description*, section 3.2, appropriately defines engineering design interfaces among NTESS organizations, ensuring the required participation and review by other programs' staff.

While NTESS's procedural framework is generally adequate, EA identified the following weaknesses in TAV-AP-025, *Calculations and Analyses Procedure*, which was updated in July 2021 to meet NQA-1 requirements (see **OFI-NTESS-1**):

- TAV-AP-025 was downgraded to "information use" instead of "reference use," which requires procedures to be "referred occasionally during an activity to confirm that the correct actions are being performed." Consequently, the probability of not meeting all procedure requirements is increased.
- Section 1.2, *Scope and Applicability*, does not address the acceptability of the previous practice of embedding calculations in other design documents. Consequently, users may elect to interpret the procedure instead of following it.
- Section 5.2.1, *Conclusions*, does not clearly communicate which other organizations or documents are or are not affected. Without clear communication of this information, configuration management cannot be ensured.

Design Verification and Documentation

TA-V Engineering Management Program Description provides an effective process for ensuring the identification, development, and maintenance of the technical baseline documents in accordance with DOE Order 420.1C, *Facility Safety*, attachment 2, chapter V, paragraph 3.c.(2). Also, TAV-AP-028, *Design Control*, provides an adequate design verification process that implements NQA-1, part I, requirement 3, paragraph 500, *Design Verification*. *TA-V Engineering Management Program Description* appropriately requires independent reviewers with an appropriate level of competency to perform design reviews, design analysis, and/or alternate calculations to confirm that design inputs (e.g., physical and performance requirements and assumptions) are correctly translated into design outputs (e.g., calculations, drawings, specifications).

In general, technical baseline documents, including design basis and supporting documents, are adequately identified, developed, and kept current to support facility safety basis development and implementation. The technical baseline is composed of drawings and calculations that appropriately support the documented safety analysis chapter 4 performance criteria. Five of the six reviewed engineering design products (five calculations and one design change package for the drive motor endcap modification) signed by independent checkers were technically correct and provided sufficient detail to allow a qualified individual to understand the analyses and verify that the results were correct without recourse to the originator. However, EA identified the following weaknesses:

- Contrary to TAV-AP-025, section 5, of calculation ACRR-CALC-2021-010, *ACRR Reactor Pool Water Overheating Event*, did not include all procedurally required information. (See **Deficiency D-NTESS-1**.) Omitting procedurally required information from a calculation means that independent reviewers cannot confirm its adequacy without recourse to the originator. ACRR-CALC-2021-010 was issued in January 2022, after TAV-AP-025 was updated to meet NQA-1 requirements. TAV-AP-025 requires the preparer to verify that the procedure has been followed in developing and reviewing the calculation, but the following procedure requirements/sections were not properly implemented:
    - No objective was stated.
    - Design inputs and their sources were not identified.
    - Results of literature searches and other applicable background data were not included.
    - The conclusion and abstract sections were not "concise."
    - References 13, 14, and 15 did not have drawing revision numbers.
- Calculation ACRR-CALC-2016-002, *NV Set-point Determination*, contains an unusual requirement for the revision of five references to be reverified prior to using the calculation results.
- Calculation ACRR-CALC-2016-002 states that "The TA-V configuration-controlled assumptions remain valid until the revision numbers used in this calculation fail to match the revisions delineated in the reference section of this calculation." The calculation originator explained that he could not recall what he meant to convey with this assumption. NTESS generated a document change request (DCR), *DCR for ACRR-CALC-2016-002*, on May 11, 2023, to clarify this language.

Engineering Design Conclusions

NTESS has established a generally adequate engineering design program. *TA-V Engineering Management Program Description* and engineering procedures are technically adequate and adhere to NQA-1 requirements. The reviewed independent design verifications for the ACRR demonstrated that the NTESS engineering organization ensures that most engineering products are technically accurate and complete. Five of the six reviewed engineering design products were technically correct, but one calculation did not adhere to calculation procedure TAV-AP-025.

3.2 Configuration Management

This portion of the assessment evaluated NTESS's CM of SS SSCs through maintenance of consistency among requirements, documents, and physical configuration, and implementation of change control to ensure safety systems continue to meet safety basis requirements and changes are properly controlled.

Consistency Among Requirements, Documents, and Physical Configuration

NTESS has established and implements generally adequate processes to ensure consistency among requirements, documents, and physical configuration for SS SSCs. *TA-V Engineering Management Program Description* adequately addresses the integration of system requirements and performance criteria identified in the documented safety analysis. *TA-V Engineering Management Program Description* also assures alignment of system requirements and performance criteria with key elements of design control, work control, change control, document control, and assessments. Procedure *TA-V Component Labeling*, dated 01/14/2021, adequately implements DOE Order 422.1, *Conduct of Operations*, section 2.r.

During facility walkdowns, physical configurations were observed to be consistent with diagrams in the SDD, including the proper labeling of most components. However, contrary to DOE Order 422.1, section 2.r, and procedure *TA-V Component Labeling*, NTESS did not properly label several observed instruments and gauges. (See **Deficiency D-NTESS-2**.) Inadequate labeling can lead to improper operation of systems necessary to operate ACRR. Procedure *TA-V Component Labeling*, section 5.1 requires the labeling, in part, of instruments and gauges. EA observed instruments and gauges on the cleanup removal system and ACRR bulk cooling system, which were not labeled. In response to these EA identified observations, NTESS generated condition report (CR)-2023-000021, *Facility Gauge and Instrument Labeling Inconsistencies*, on June 6, 2023, to address this non-compliance.

Change Control

The changes to system requirements, documents, facility procedures, and installed components that EA reviewed demonstrated generally adequate change control. *TA-V Engineering Management Program Description* provides an effective process for formally controlling changes to system requirements, documents, and installed components. The one design change package implemented in the last six years at the ACRR was appropriately reviewed by all necessary organizations. This change was appropriately evaluated by nuclear safety specialists using the unreviewed safety question (USQ) process and was appropriately screened out as a system change that did not involve a USQ. Affected design documents, installation instructions, post-modification testing instructions, and acceptance criteria were appropriately identified and included in the change process. However, contrary to DOE Order 420.1C, attachment 2, chapter V, section 3.c.(1), and DOE-STD-1073-2016, *Configuration Management*, section 4.9 (invoked by *TA-V Engineering Management Program Description*, section 1.3), NTESS did not perform a complete and thorough review of the proposed changes to the *TA-V Component Labeling* procedure in January 2021 to identify needed labeling of SSCs affected by the change. (See **Deficiency D-NTESS-3**.) Lack of effective change management created an unrecognized, non-conforming condition in the ACRR (see subsection above). The review and approval process of the *TA-V Component Labeling* procedure did not recognize that components, instruments, and gauges in the ACRR were not labeled in accordance with the new revision dated 01/14/2021.

Configuration Management Conclusions

NTESS implements an adequate CM program that generally meets requirements in accordance with DOE Order 420.1C and DOE-STD-1073-2016. System configurations were consistent with design

requirements, performance criteria, and documentation. Design changes were appropriately reviewed through the USQ process and controlled through engineering, installation, and operations. However, weaknesses were identified in the areas of equipment labeling and document change control.

3.3 Cognizant System Engineer Program

This portion of the assessment evaluated NTESS's implementation of its cognizant system engineer (CSE) program, including the ACRR RSS SDD and CSE system assessments, to ensure safety systems can reliably perform as intended.

CSE Program Implementation

NTESS effectively implements its CSE program through *TA-V Engineering Management Program Description*, which appropriately establishes the program scope and CSE roles and responsibilities, training and qualification requirements, and assignments.

CSE training and qualification requirements are adequately described in *System Engineer Training and Qualification Program (SETQP)*, dated 06/01/2022. Qualification cards for all four currently qualified CSEs showed that the CSEs have appropriately completed all training and qualification program requirements, including an oral board examination, thereby meeting the requirements of DOE Order 420.1C and DOE Order 426.2, *Personnel Selection, Training, Qualification, and Certification Requirements for DOE Nuclear Facilities*. Interviews and system walkdowns with each of these CSEs demonstrated their detailed knowledge of assigned systems. Qualification cards for three additional CSEs in training showed appropriate progress toward full qualification.

NTESS effectively manages active SS SSCs, CSE assignments, and the SDD. *ACRR Safety SSC CSE Designation*, dated 04/24/23, accurately lists each of the four active SS SSCs and identifies the assigned CSE. This document further identifies passive SSCs and design features, assigns CSEs in training to these systems, and appropriately specifies the subcomponents to be maintained in the master equipment list. NTESS has also developed an adequate *TA-V System Design Descriptions*, dated 03/09/2023, document for the ACRR, appropriately describing the requirements for the development and maintenance of SDDs.

System Design Description

The *Annular Core Research Reactor (ACRR) Reactor Safety System (RSS) System Design Description (SDD)*, dated 07/08/2019, meets the requirements of DOE Order 420.1C as it was developed in accordance with DOE-STD-3024-2011, *Content of System Design Descriptions*. It appropriately covers all four active SS SSCs credited in the safety basis and accurately reflects safety basis requirements, including system testing, performance criteria, and the basis for requirements. The ACRR RSS SDD appropriately addresses off-normal operations, such as loss of power, in order to assess potential failure modes and system weaknesses. CSEs demonstrated excellent knowledge, understanding, and ownership of their assigned sections of the SDD. However, contrary to DOE Order 420.1C, attachment 2, chapter V, section 3.c.(2), NTESS has not updated the SDD to reflect the status of the transient rod withdrawal (TRW) submode operations upgrade. (See **Deficiency D-NTESS -4**.) Inaccurate SDDs can result in improper operations, maintenance, or procurement related to safety SSCs. NTESS identified this issue in the contractor management self-assessment in October 2022 and entered a condition report in the issues management system. In December 2022, the NTESS contractor readiness assessment for TRW again identified this issue as a post-start finding. The March 2023 Federal readiness assessment identified this issue as a pre-start finding.

CSE System Assessments

CSEs have performed and documented generally adequate quarterly and annual system assessments addressing system operability, reliability, and material condition of safety systems in accordance with *System Walkdowns and System Health*, dated 10/06/2020, as demonstrated in the two most recent quarterly SHRs. *TA-V Engineering Management Program Description* appropriately requires periodic physical configuration and system performance assessments by qualified experts. One of the four SS SSCs appropriately receives a required annual assessment during each quarter, meeting the requirements of this procedure. Trending of system performance is appropriately performed and documented in the SHR. However, contrary to DOE Order 414.1D, *Quality Assurance*, attachment 2, criterion 5.a and *System Walkdowns and System Health*, section 5.4, item 9, NTESS has not ensured that all SHR walkdown summary paragraphs include procedurally required information. (See **Deficiency D-NTESS-1**.) Omitting the scope of the walkdown and any special emphasis areas from the walkdown summary does not communicate the thoroughness of inspections performed and could result in uninspected components. For example, for the two most recent quarters, SHR system walkdown summaries (each addressing all four active systems) simply stated that "the system components were assessed to determine the as-found condition."

TA-V performance metrics appropriately address SSC operability, reliability, and material condition, as discussed in section 3.6 of this report. However, interviews with the CSE manager confirmed that NTESS does not maintain any metrics for the performance of the CSE program, such as qualification status, engineering product delivery, or system modification status.

Cognizant System Engineer Program Conclusions

NTESS implements an adequate CSE program. Qualified CSEs are appropriately assigned to all active SS SSCs. The ACRR RSS SDD reflects system requirements and performance criteria in accordance with safety basis requirements. CSEs demonstrated a thorough understanding of their assigned systems, and they perform and document generally adequate quarterly and annual system assessments. However, the ACRR RSS SDD was not kept current, and the SHR walkdown summary paragraphs did not specify the scope of the walkdown or special emphasis areas as required.

3.4 Safety System Surveillance and Testing

This portion of the assessment evaluated NTESS's performance of surveillance and testing and the use of measuring and test equipment (M&TE) are properly performed in accordance with technical safety requirement (TSR) surveillance requirements (SR) and specific administrative controls.

Surveillance and Testing

NTESS has established and implemented generally adequate TSR and specific administrative controls surveillance and testing procedures. NTESS adequately performs safety system surveillance and testing activities to ensure that the SS SSCs can accomplish their safety functions and continue to meet applicable system requirements and performance criteria. NTESS adequately performed the ACRR pool water resistivity test surveillance in accordance with ACRR-OP-005, *Facility Startup*. The completed pre-operational checklist satisfied the monthly ACRR pool water resistivity test requirement. The reactor operator was knowledgeable of the procedure and performed it efficiently.

The eight reviewed surveillance procedures for the ACRR systems appropriately cited applicable safety requirements; identified precautions and system and test prerequisite conditions; and included clear performance steps. These surveillance procedures also included provisions for listing discrepancies and

timely notification of facility management of any test failure so that the system can be declared inoperable and necessary actions taken to place the facility in a safe condition. The procedures were appropriately reviewed and approved by the reactor supervisor and the facility manager. NTESS uses an effective scheduling and tracking system to ensure that surveillances are performed within technical safety requirement-required frequencies; consequently, no surveillances have been missed in the last two years. However, weaknesses with three of the SR procedures were identified and are addressed in section 3.5 of this report.

While surveillance procedure content is generally adequate, contrary to DOE Order 414.1D, attachment2, criterion 5.a, and *Document Lifecycle Management Procedure* (DLMP), dated 08/04/2022, section 6.1.1, five of eight TSR SR procedures were not categorized as "continuous use." (See **Deficiency D-NTESS-1**.) SR procedures as "reference use" could result in the improper performance of a surveillance tests and subsequent TSR violation. The DLMP allows "reference use" procedures for "operations of lesser consequence. "Continuous use" procedures are required per the DLMP for operations in which the consequence of an improper action could have an immediate impact on safety, production, or reliability, requiring the step to be read prior to performance and checked off when completed. By definition, violation of TSR SR procedures can potentially impact safety, production, or reliability.

Measuring and Test Equipment

NTESS adequately controls M&TE used to perform surveillance procedures. Review of five performed surveillance procedures using calibrated M&TE demonstrated that M&TE was appropriately calibrated and maintained at prescribed intervals (or before use) against reference calibration standards. The work records appropriately recorded calibration information and specified the accuracy required for the test. Interviews confirmed that all calibrated M&TE used for surveillance testing was appropriately under the control of the Operations organization. Operators demonstrated adequate understanding of the actions to take for out-of-calibration M&TE. Operators also demonstrated appropriate understanding of the calibration recall system.

Safety System Surveillance and Testing Conclusions

NTESS adequately performed the observed safety system surveillance and testing activities. NTESS adequately performed the ACRR pool water resistivity test in accordance with the approved surveillance procedure. NTESS has established and implemented generally adequate surveillance procedures using controlled M&TE and an effective surveillance scheduling system. However, weaknesses were identified in the categorization and/or content of some surveillance procedures.

3.5 Quality Assurance

This portion of the assessment evaluated NTESS's implementation of an approved QA program (QAP) for TA-V training and qualification of QA personnel, procedures, procedure implementation, procurement and critical spare parts verification of SS SSCs that ensures safety systems will conform to required standards and perform as designed.

Approved Quality Assurance Program

NTESS has appropriately established a NNSA-approved QAP, *TA-V Management System*, dated 05/31/2022. This management system and the implementing procedures appropriately work in conjunction with the SNL-NM QAP to meet the QA requirements in 10 CFR 830, *Nuclear Safety Management*, subpart A, *Quality Assurance Requirements*, and DOE Order 414.1D, *Quality Assurance*. The QAP implements NQA-1, an appropriate consensus standard for nuclear facilities. For TA-V, NTESS

has appropriately adopted the entirety of NQA-1, part I and part II, subpart 2.7, *Quality Assurance Requirements for Computer Software for Nuclear Applications*, and subpart 2.14, *Quality Assurance Requirements for Commercial Grade Items and Services*. The QAP is adequately implemented through an established QA organization with an assigned Nuclear Quality & Requirements Manager responsible for the implementation, assessment, maintenance, and improvement of the QAP.

Training and Qualification of QA Personnel

NTESS training and qualification of QA personnel are generally adequate. *TA-V Training Program Manual (TPM) for Nuclear Facilities*, dated 05/26/2022, provides an effective training and qualification approach that includes personnel selection, initial training, continuing training, qualification, and certification. QA personnel are appropriately trained in accordance with *Quality Support Training Requirements*, dated 02/23/2023, in performing audits and assessments that address compliance and performance and include evaluation criteria. Training is appropriately augmented by formal procedures and on-the-job training performing audits and assessments, including system walkdowns, to provide QA personnel a thorough understanding of operational features, safety requirements, and performance criteria for SSCs. The reviewed nuclear lead auditor qualification forms (completion of required participation in five audits/assessments, including one nuclear QA audit, within the year prior to qualification) for three auditors and their training certificates of completion demonstrated adequate training for conducting QA audits and assessments. Procedure TAV-AP-024, *Inspection, Test, and Special Process Control*, appropriately provides a process for performing non-procurement related inspections that verify conformance of SS SSCs to specified requirements or verify continued acceptability of SSCs already in service or to be placed in service.

Most aspects of the NTESS QA personnel training and qualification program are adequate. However, contrary to DOE Order 426.2, attachment 1, chapter I, section 4.b.(3)(a), NTESS is using CSE personnel to perform quality control inspections for which they are not trained and qualified. (See **Finding F-NTESS-1**.) Not properly training personnel to perform required quality control inspections may result in inadequate inspection results. DOE Order 426.2, attachment 1, chapter I, section 4.b.(3)(a), requires technicians to be qualified to perform the tasks associated with their specialty; technicians are defined as personnel involved in, for example, inspections associated with quality control. Currently, CSEs are performing quality control inspections, including item receipt inspections for SS SSCs purchased and received in accordance with TAV-AP-021, *TA-V Procurement Procedure*. The reviewed training and qualification records for the CSEs assigned to TA-V did not adequately address appropriate training for performing quality control inspections. Interviewed NTESS managers explained that no TA-V personnel have been trained and qualified to perform quality control inspections.

Procedures

The QAP is implemented through a suite of generally adequate procedures. Procedures addressing design, surveillances, preventive maintenance, and contractor assurance management are adequately documented in accordance with the document management process. However, contrary to DOE Order 414.1D, attachment 2, criterion 4.a, the following procedure inaccuracies, inadequacies, and conflicting requirements were identified (see **Deficiency D-NTESS-5**):

- ACRR-MP-002, *Power Determination by Pool Heat Up*, was designed to test one or two Plant Protection System (PPS) detector channels but provides a data record sheet for only one channel. When two channels are tested, the test record includes two page 24s. PPS is a SS SSC.
- ACRR-MP-011, *Transient Rod Worth Determination*, appendix A, does not specify an appropriate range for a test data point recorded in the data table form. When EA informed NTESS of this issue, operations personnel concurred and initiated a change request to revise the data table.

- ACRR-MP-019, *Rod Drive Calibration*, does not provide NTESS operators a means of recording the software filename used in the process, so operators have recorded this information in the margins. Without a place to record the filename, operators may forget to record the information.
- The DLMP and the *TA-V Assurance Management Program Procedure*, dated 06/03/2022, are in conflict. The DLMP, section 6.7 states that "If a DCR is used to define and justify a solution, then do not close the associated condition/corrective action until the DCR is implemented." In contrast, the *TA-V Assurance Management Program Procedure*, section 3.3.1, step 19 states: "Identify the evidence or deliverable required to demonstrate and document completion of the CA (e.g., Facility Work Request, an updated procedure or document, Engineering Change Notice, Document Change Request, Photos, etc.)." This step improperly allows closure of a corrective action (CA) after DCR issuance. Consequently, NTESS improperly closed CR-2022-000040 and CA-2023-000010 before all CAs were completed. The *NQA-1-2017 Self-Assessment Internal Audit Report* completed in November 2022 identified that TAV-AP-028 does not reference NQA-1. CR-2022-000040 and CA-2023-000010 were initiated to identify the deficiency and specify the CA. Both the CR and CA were closed in February 2023 after issuance of a DCR to revise procedure TAV-AP-028; however, the procedure was not revised until June 2023.
- *TA-V Drawings Procedure*, dated 07/10/2018, does not reference NQA-1, but instead contains an outdated reference to ANSI/ANS 15.8, *Quality Assurance Program Requirements for Research Reactors*.

Inaccurate procedures and conflicting requirements could lead to performing unauthorized actions with potential adverse impacts on nuclear safety.

Procedure Implementation

The observed procedure implementation was generally adequate. NTESS operators appropriately performed the observed facility opening pre-operation process in accordance with the governing procedure. The operator exhibited careful attention to detail in achieving all procedural steps. One observed maintenance activity performed in accordance with the governing procedure, which was carefully followed by the operator, resulted in a proper valve line-up of a safety support system. However, EA identified the following weaknesses.

- Contrary to DOE Order 414.1D, attachment 2, criterion 5.a, four of the eight reviewed process completion records did not adhere to the requirements of the governing procedure. (See **Deficiency D-NTESS-1**.) Improper adherence to procedures could lead to inadequate work process results. Specifically, the following weaknesses were identified:
    - ACRR-MP-002, *Power Determination by Pool Heat Up*, exhibited a revised test average entry without adequate justification for the change.
    - ACRR-MP-006, *Preventative Maintenance and Surveillance*, included several out-of-range readings without any identified CA.
    - ACRR-MP-015, *Ventilation Testing and Surveillance*, exhibited an out-of-range pitot tube measurement without any identified CA.
    - For ACRR-MP-019, *Rod Drive Calibration*, the Deviations/Remarks section identified several problems with the calibration, but all steps in the procedure were marked as complete.

Procurement and Critical Spare Parts Verification

TAV-AP-021 addresses a generally adequate process for NQA-1 compliant supplier procurements and procuring items subject to commercial-grade dedication (CGD). NTESS acquired new and replacement RSS SS SSCs through a generally appropriate CGD process in accordance with TAV-AP-030, *TA-V Commercial Grade Dedication Procedure*, which adequately implements NQA-1, part II, subpart 2.14. One reviewed purchase order for a computer server for the RSS contained the appropriate technical requirements and specifications consistent with the design requirements. The reviewed acceptance documentation for this purchase order included the appropriate suspect/counterfeit item reviews and receipt inspection documentation with defined acceptance criteria, all of which aligned with the procurement requirements. All three of the reviewed CGD packages for RSS SSCs (ACRR wide range key switch card, flexi-boron shielding, and RSS computer servers) adequately identified appropriate critical characteristics with attributes important to their respective safety functions and corresponding acceptance criteria. Receipt inspection documentation for these CGD packages demonstrated appropriate inspection of physical attributes, performance of tests, and control of suspect/counterfeit items. However, NTESS has not established a process that implements the requirements of TAV-AP-021 for the selection and evaluation of prospective suppliers based on specified criteria. (See **OFI-NTESS-2**.)

Walkdown of a critical spare parts storage area demonstrated that NTESS adequately maintains critical spare parts for ACRR systems in a secured storge area with limited access by operations personnel in the ACRR. Operations personnel adequately maintain and update a critical spare parts list, and CSEs appropriately evaluate the availability of critical parts in coordination with operations.

Quality Assurance Conclusions

NTESS has appropriately established a DOE-approved QAP that meets DOE Order 414.1D and NQA-1 requirements. NTESS has established an effective lead auditor training program and has an adequate qualified lead auditor staff to conduct audits and assessments. The QAP is implemented through a suite of generally adequate procedures. Limited observation indicated that procedural implementation was adequate. NTESS acquired new and replacement RSS SS SSCs through an appropriate CGD process. However, EA identified weaknesses in the training and qualification of independent quality control inspectors, and in the implementation of some procedures.

3.6 Feedback and Improvement

This portion of the assessment evaluated NTESS's identification of safety system issues and prevention of recurrence through line management actions and a contractor assurance system (CAS) that includes periodic assessments, CAs, and performance indicators/measures.

Assessments

In general, NTESS has appropriately established and implemented a CAS that includes the ACRR to identify the causes of problems and prevent recurrence, thus meeting the requirements of DOE Order 226.1B, *Implementation of Department of Energy Oversight Policy*, attachment 1. *TA-V Assurance Management Program Procedure* appropriately requires periodic management and independent assessments of systems engineering, CM, maintenance, surveillance and testing, and operations for credited safety systems. The reviewed *FY23 Integrated Assessment Schedule* reflects a risk-informed planning approach that appropriately covers programs and controls for potentially high-consequence activities.

NTESS management and independent assessment reports provide adequate feedback information on acceptable performance and processes and on issues in need of improvement. For example, a reviewed management self-assessment report issued in November 2022 demonstrated appropriate evaluation of reactor operator training, facility operations, approved safety documentation, facility modifications, draft restart planning, and operations procedures; these were required to ensure that ACRR activities, processes, and operations were adequately implemented to restart TRW operations. The reviewed fiscal year (FY) 2023 *FY23 NQA-1-2017 Internal Audit Final Report*, also issued in November 2022, demonstrated an appropriate independent evaluation of TA-V's implementation of NQA-1 at the ACRR, identifying issues, OFIs, and noteworthy practices, and fulfilling SFO contract direction. This independent audit was self-critical, identifying 8 findings, 1 observation, 14 OFIs, and 5 noteworthy practices, which fulfilled the audit required by the TA-V declaration of NQA-1 implementation to SFO; the auditors were personnel who do not have direct responsibility for performing the activities being audited. The eight reviewed findings from this internal audit were appropriately managed through the *TA-V Assurance Management Program Procedure*. For example, a CR and CA were developed to address the finding for failure to identify "NQA-1-2017" in the design control procedure. However, the CA was closed after DCR issuance but before revision of the procedure (see section 3.5 of this report).

Corrective Actions

NTESS has appropriately established a process to identify, characterize, monitor, and close CAs and to verify their effectiveness. For 12 reviewed CAs initiated under the previous quality program before May 2022 (when NTESS declared implementation of NQA-1 as its new quality system), system deficiencies were appropriately entered and tracked in the issues management process. However, six of those CAs, which related to transient rod breakage and were prepared in 2014, remain open due to technical resolution issues. NTESS is currently developing a testing system to help resolve the technical issues for the transient rods assemblies. The other six CAs, not related to the transient rod breakage, also remain open. Additionally, the following timeliness issues for CAs were identified:

- Of 19 reviewed CAs initiated since NQA-1 implementation (i.e., May 2022), 70% of CRs and CAs have not been completed in a timely manner (open for more than six months).
- Several CA due dates identified in the SHRs were overdue. After this issue was raised, NTESS extended the CA due dates; however, the revised CA due dates exceed the associated CR due dates.
- *Management Self-Assessment for Transient Rod Withdrawal Operations for the ACRRF at Sandia National Laboratories*, issued in November 2022, includes assessment results categorized as "Observation-Significant Recommendations," which is not defined in the *TA-V Assurance Management Program Procedure*. As a result, the categorization of nine associated CAs is not defined. Five of the nine CAs requiring updates to procedures have been closed. However, the priority for closing the four open CAs is not clear since these items are observations that are not categorized as events (as defined by *TA-V Assurance Management Program Procedure*), and they may not be resolved in a timely manner.

DOE Order 226.1B and NQA-1, requirement 16, *Corrective Action*, require that deficiencies (i.e., conditions adverse to quality) shall be identified and corrected in a timely manner. *TA-V Assurance Management Program Procedure* adequately addresses an event timeline, defining "events" as situations that may have an undesirable effect on the safety or health of people, security, or the environment, including operational events, such as environment, safety, and health occurrences; security incident management program reportable incidents; and non-conformances. The purpose of the event timeline is to help determine the timeframe for managing each step of the CA process, including CA plan, causal analysis, and validation of the CA. However, contrary to DOE Order 226.1B, attachment 1, sections 2.b.(3) and 2.b.(5), and NQA-1, requirement 16, *TA-V Assurance Management Program Procedure* does

not define a process for assessing issue significance or address the timeliness of resolution for issues not meeting the criteria of an event. (See **Deficiency D-NTESS-6**.) Not resolving issues in a timely manner could result in increased risk to the safety of workers and the public.

Performance Indicators/Measures

The reviewed key performance indicator (KPI) metrics demonstrated that NTESS adequately communicates ACRR performance trends and analysis of results via periodic reports to NTESS and SFO senior leadership. The *SHR ACRR RSS 2023 Q1* quarterly report includes links to KPI memoranda for all four active safety systems and can be accessed by site personnel. KPI metrics for the operability, reliability, maintainability, material conditions, and maintenance backlog of all four active safety systems are appropriately included in SHRs on a quarterly basis. KPI metrics for inadvertent shutdowns of the PPS and WRS are also appropriately included in these SHRs. In addition, the report identified that during the walkdown and the weekly ACRR meetings, the operation and performance of the reactivity control system, instrumentation and control, PPS, and WRS were effectively communicated to the facility supervisor and other ACRR operators. These metrics identify trending information that currently does not show any positive or negative trends. Line management uses these metrics to address negative trends in a timely fashion. For example, this SHR report identified deficiencies related to the SS Reactivity Control System's differing water resistivity measurements at various depths in the reactor pool leading to discussions to resolve this issue.

Feedback and Improvement Conclusions

For the ACRR, NTESS has appropriately established and implemented a CAS that is adequately supported by line management and meets the requirements of the DOE order. Periodic safety system assessments have been adequately conducted, and appropriate CAs were taken. The reviewed CAs were appropriately conducted and tracked, but several CAs have not been completed in a timely manner. The reviewed performance metrics were appropriately used to identify performance trends, resolve potential problems and improve safety systems.

3.7 Federal Oversight

This portion of the assessment evaluated the effectiveness of SFO's oversight program at TA-V. This evaluation examined a broad spectrum of SFO oversight activities at TA-V, and as such, does not constitute a focused safety system oversight (SSO) program review.

SFO's oversight of NTESS, including safety system oversight, is implemented by Procedure 0804, *Sandia Field Office Oversight of the Management and Operating Partner*, which incorporates the requirements of DOE Order 226.1B, *Implementation of Department of Energy Oversight Policy*, as well as NNSA Supplemental Directive 226.1C, *NNSA Site Governance*. The oversight process begins with risk assessment, leading to the development of the site integrated assessment plan, followed by planning and conducting oversight activities.

Overall, the SFO oversight procedure adequately provides for tailoring of Federal oversight to CAS effectiveness and degree of risk and reflects a mature oversight approach. The procedure also provides guidance concerning attributes important to the conduct of oversight, as well as provisions for reassessing risk and planned oversight activities following events and new oversight results. The last assessment performed by SFO at TA-V in the area of QA was in August 2022, a few months after NTESS's implementation of the NQA1 quality systems. This assessment reviewed four out of the ten criteria from DOE Order 414.1D, as well as the requirements of Attachment 3, *Suspect/Counterfeit Items Prevention*, and Attachment 4, *Safety Software Quality Assurance Requirements for Nuclear Facilities.* Since NQA-1

implementation, SFO has performed a shadow assessment of a CAS assessment of NQA-1 at TA-V but has not conducted an independent assessment or integrated oversight activity assessment that evaluates the implementation of all ten criteria of DOE Order 414.1D. EA identified several weaknesses in NTESS's implementation of its QA program as approved by SFO. (See **OFI-SFO-1**.)

SFO field oversight at TA-V is conducted primarily by staff under the SFO Assistant Manager for Engineering (AME), who assigns a Nuclear Operations Team Lead to TA-V to be responsible for helping with the integration of TA-V oversight activities by managing the communication between SFO management and other SFO subject matter experts. The AME currently has one qualified Facility Representative (FR) assigned to TA-V, working with two FRs who are in training and will be assigned to TA-V facilities once their qualifications are completed (currently scheduled for the1st and 2nd quarters of FY 2024). The qualified TA-V FR is also qualified under the SSO functional area qualification standard and serves as the cognizant TA-V SSO.

The SFO qualification program is guided by Procedure 0603.03, *Technical Qualification Program*. During interviews, the qualified FR assigned to TA-V demonstrated a strong emphasis on partnering with NTESS staff and management, as well as a good grasp of the operational considerations specific to the ACRR. The FR's weekly written reports contain an excellent level of detail and demonstrate a breadth of functional area operational awareness, as well as a questioning attitude in several instances.

SFO documents and stores operational awareness activities (OAAs) within a Microsoft SharePoint system called the "OAA Tracker." These OAAs are tagged with the assessor's name, the type of oversight activity, site and facility, and a comment field for a narrative description of the oversight result and similar information. In addition, the AME has developed additional functionality that allows visualization and analysis of OAA aggregate statistics.

Federal Oversight Conclusions

Overall, SFO is meeting the requirements of DOE Order 226.1B by maintaining sufficient technical capability and knowledge of site and contractor activities to make informed decisions about hazards, accepting nuclear safety risks, and resource allocation. EA plans to conduct a future assessment with a focus on SSO oversight.

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

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Finding F-NTESS-1: NTESS has not established training and qualification requirements for personnel engaged in quality control inspections. (DOE Order 414.1D, att. 2, secs. 2 and 8, and DOE Order 426.2, att. 1, ch. I, sec. 4.b.(3)(a))

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-NTESS-1: Several issues were noted with respect to QA Criterion 5: (1) NTESS calculation ACRR-CALC-2021-010 did not include all procedurally required information; (2) NTESS has not ensured that all SHR walkdown summary paragraphs include procedurally required information; (3) NTESS has not ensured that all SR procedures are correctly categorized as "continuous use" procedures; and (4) NTESS has not ensured that all process completion records adhere to the requirements of the governing procedure. (DOE Order 414.1D, att. 2, criterion 5.a)

Deficiency D-NTESS-2: NTESS has not ensured that all system instrumentation and gauges are labeled. (DOE Order 422.1 att. 2 sec. 2.r)

Deficiency D-NTESS-3: NTESS did not perform a complete and thorough review of the proposed *TA-V Component Labeling* procedure revision in January 2021 to identify needed labeling of ACRR system instrumentation and gauges affected by the change. (DOE Order 420.1C, att. 2, ch. V, sec. 3.c.(1) and DOE-STD-1073-2016, sec. 4.9)

Deficiency D-NTESS-4: NTESS has not ensured that the ACRR Reactor Safety System, SDD is kept current, particularly with regard to completing timely updates following system design changes. (DOE Order 420.1C, att. 2, ch. V, sec. 3.c.(2))

Deficiency D-NTESS-5: Several NTESS procedures contain inaccuracies and conflicting requirements. (DOE Order 414.1D, att. 2, criterion 4.a)

Deficiency D-NTESS-6: NTESS *TA-V Assurance Management Program Procedure* does not define a process for assessing deficiency significance or address the timeliness of resolution of deficiencies not meeting the criteria of an event. (DOE Order 226.1B, att. 1, secs. 2.b.(3) and 2.b.(5) and NQA-1, requirement 16)

7.0 OPPORTUNITIES FOR IMPROVEMENT

EA identified the OFIs 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. 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.

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OFI-NTESS-1: Consider making TAV-AP-025 a "reference use" procedure, with appropriate revisions to eliminate areas where interpretation is required and to require that the conclusions clearly state what other organizations/documents are or are not affected.

OFI-NTESS-2: Consider establishing a process for TA-V personnel to evaluate and select suppliers based on specified safety function and performance criteria and to ensure that approved suppliers continue to provide acceptable SS SSCs and services.

Sandia Field Office

OFI-SFO-1: Consider evaluating results of the latest assessments in the area of QA and consider changes to the SFO risk assessment of NTESS QA performance at TA-V facilities.

Appendix A
Supplemental Information

Dates of Assessment

Onsite Assessment: May 1-5 and June 5-9, 2023

Office of Enterprise Assessments (EA) Management

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William F. West, Deputy Director, Office of Enterprise Assessments
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