

**Office of Enterprise Assessments Targeted
Review of Nuclear Reactor Facility Operations at
Sandia National Laboratories**



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Acronyms

ACRR	Annular Core Research Reactor
AOP	Abnormal Operating Procedure
CAS	Contractor Assurance System
CFR	Code of Federal Regulations
CM	Configuration Management
CONOPS	Conduct of Operations
CRAD	Criteria, Review, and Approach Document
CSE	Cognizant System Engineer
DOE	U.S. Department of Energy
DSA	Documented Safety Analysis
EA	Office of Enterprise Assessments
FR	Facility Representative
LCO	Limiting Condition for Operation
M&TE	Measuring and Test Equipment
NNSA	National Nuclear Security Administration
OAA	Operational Awareness Activity
OFI	Opportunity for Improvement
OJT	On-the-Job Training
PSL	SNL Primary Standards Laboratory
RCT	Radiological Control Technician
RTWD	Radiological Technical Work Document
SAT	Systematic Approach to Training
SDD	System Design Description
SFO	Sandia Field Office
SMP	Safety Management Program
SNL	Sandia National Laboratories
SR	Surveillance Requirement
SSC	Structures, Systems, and Components
SSO	Safety System Oversight
T&Q	Training and Qualification
TA	Technical Area
TIM	Training Implementation Matrix
TPP	Training Program Plan
TSR	Technical Safety Requirement
TTJA	Tabletop Job Analysis

Office of Enterprise Assessments Targeted Review of Sandia National Laboratories Nuclear Reactor Facility Operations

EXECUTIVE SUMMARY

The U.S. Department of Energy (DOE) Office of Nuclear Safety and Environmental Assessments within the independent Office of Enterprise Assessments (EA) conducted an oversight review of the Sandia National Laboratories (SNL) nuclear reactor facility operations. SNL is managed and operated by Sandia Corporation for DOE. This review was part of a targeted assessment of nuclear reactor facility operations across the DOE complex.

Nuclear reactor facility operations was identified as a targeted review area in an EA memorandum to DOE senior line management entitled *Office of Enterprise Assessments Nuclear Safety, Worker Safety and Health, and Emergency Management Assessment Strategies and Activities*, dated February 5, 2015. The memorandum also stated that performance of DOE oversight would be evaluated during the targeted reviews to provide input to an overall evaluation of DOE Federal assurance capability. Pursuant to this memorandum, EA reviewed and assessed the effectiveness of nuclear reactor facility operations at SNL, specifically at the Annular Core Research Reactor (ACRR) facility. The review evaluated the flowdown and implementation of DOE requirements to ensure that activities are conducted safely and in accordance with requirements. The review also evaluated the effectiveness of DOE oversight of nuclear reactor facility operations.

Overall, SNL is conducting ACRR facility operations effectively, safely, and in accordance with requirements based on the sample of activities, interviews and documents reviewed during this assessment. Operations activities are well established and effectively implemented. Reactor operators are well informed of conditions and properly comply with procedures. SNL has established adequate assessment processes, and the corrective action program at ACRR is well established for resolving facility problems in a timely manner. SNL has developed and implemented a comprehensive initial operator training, qualification, and certification program that meets, and in some cases exceeds, applicable DOE requirements and results in highly competent reactor operators and supervisors. ACRR surveillances and limiting conditions for operation effectively maintain the operability and quality of safety structures, systems, and components within safety limits. The electronic configuration management tool for keeping all ACRR system design documents current in real time is a strength. Reactor operators and cognizant system engineers have the experience and knowledge to ensure that nuclear safety requirements are maintained. SNL has implemented irradiated experiment hazard controls sufficient to ensure the safety of workers and the public, as well as conformance to safety requirements.

Although ACRR facility operations were generally positive, EA identified some deficiencies for line management consideration: operations procedures do not ensure surveillance requirement acceptance criteria are clearly documented; procedures for material handling and hazard analysis for experiments are not up to date; performance-based self-assessments are not being sufficiently conducted; operator continuing training on abnormal operating procedures are not conducted annually; system design description documents are not up to date; and potential high radiation areas do not have physical controls.

The Sandia Field Office oversight process is generally sound for performance-based oversight activities at the ACRR. The Field Office has assigned a knowledgeable Facility Representative and safety system oversight representative who conduct routine oversight activities. However, EA noted a few isolated deficiencies in oversight support, oversight planning, and periodic evaluation of oversight-related data.

Office of Enterprise Assessments Targeted Review of Sandia National Laboratories Nuclear Reactor Facility Operations

1.0 PURPOSE

The U.S. Department of Energy (DOE) independent Office of Enterprise Assessments (EA) conducted a review of nuclear reactor facility operations at Sandia National Laboratories (SNL), specifically at the Annular Core Research Reactor (ACRR) facility. This review was conducted within the broader context of a series of targeted assessments to ensure that systems and techniques at DOE nuclear reactor facilities are in accordance with regulatory requirements and provide acceptable protection of the health and safety of the public and workers. EA performed this targeted review at SNL from November 16 to 20, 2015.

2.0 SCOPE

As specified in the *Plan for the Office of Enterprise Assessments Targeted Review of Nuclear Reactor Facility Operations at Sandia National Laboratories*, the EA team evaluated the flowdown and implementation of DOE requirements to ensure that activities are conducted safely and in accordance with requirements. The review also evaluated the effectiveness of DOE's oversight of nuclear reactor facility operations. The review was scheduled for a period of expected operations; however, due to a pause in operations for troubleshooting a suspected fuel element failure, EA was not able to observe actual reactor operations.

3.0 BACKGROUND

SNL is operated and managed by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation. As a contractor for the DOE's National Nuclear Security Administration (NNSA), Sandia Corporation operates SNL, which supports numerous Federal, state, and local government agencies, companies, and organizations. At the ACRR facility, located in Technical Area (TA)-V, SNL researchers can subject various test objects to a mixed photon and neutron irradiation environment featuring either a short duration power pulse of up to 60,000 megawatts of power for several milliseconds or a long-term, steady-state rate of up to 4 megawatts. Because of the relatively low steady state power capability (i.e., less than 20 megawatts), the ACRR facility is classified as a hazard category 2 nuclear facility and is also referred to as a category B reactor. The Sandia Field Office (SFO) provides DOE/NNSA oversight of SNL and the ACRR facility.

The EA independent oversight program is designed to enhance DOE safety and security programs by providing the Secretary and Deputy Secretary of Energy, the Under Secretaries of Energy, other DOE managers, senior contractor management, Congress, and other stakeholders with an independent evaluation of the adequacy of DOE policy and requirements and the effectiveness of DOE and contractor line management performance and risk management in safety and security and other critical functions as directed by the Secretary. The DOE independent oversight program is described in and governed by DOE Order 227.1 *Independent Oversight Program*, and EA implements the program through a comprehensive set of internal protocols, operating practices, assessment guides, and process guides.

EA identified nuclear reactor facility operations as an area for targeted reviews in a memorandum to DOE senior line management entitled *Office of Enterprise Assessments Nuclear Safety, Worker Safety and Health, and Emergency Management Assessment Strategies and Activities*, dated February 5, 2015. The memorandum also stated that during the targeted reviews, EA would evaluate the performance of DOE

field element oversight to provide input to an overall evaluation of DOE Federal assurance capability.

4.0 METHODOLOGY

As identified in the review plan, this review evaluated the flowdown and implementation of DOE requirements to ensure that activities are conducted safely and in accordance with requirements.

The review also evaluated the effectiveness of DOE oversight of nuclear reactor facility operations. The principal criteria of this targeted review were based on selected objectives and criteria from the following sections of EA Criteria, Review, and Approach Document (CRAD) 31-08, Rev. 0, *Nuclear Reactor Facility Operations*:

- 4.3 Operations – Operations Activities, Logs, and Records
- 4.5 Operations – Self-Assessments and Reviews
- 4.6 Training and Qualification – Operator Certification and Continuing Training
- 4.7 Safety Basis – Surveillances and Limiting Conditions for Operation (LCOs)
- 4.9 Safety Basis – Experiments
- 4.14 DOE Field Element Oversight.

The EA team examined key documents, such as system descriptions, work packages, procedures, manuals, analyses, policies, and training and qualification (TQ) records; interviewed key personnel responsible for developing and executing the associated programs; observed operating and maintenance activities; and walked down significant portions of the ACRR facility, focusing on nuclear reactor facility operations. The members of the EA review team, the Quality Review Board, and EA management responsible for this review are listed in Appendix A. A detailed list of the documents reviewed, personnel interviewed, and observations relevant to the conclusions of this report are provided in Appendix B.

5.0 RESULTS

5.1 Operations – Operations Activities, Logs, and Records

Criteria:

Reactor facility operations practices are established and implemented to ensure that operators are alert, informed of conditions, and operate equipment properly; and to ensure thorough, accurate, and timely recording of equipment information for performance analysis and trend detection. (DOE Order 422.1)

ACRR facility operational logs and records are sufficiently detailed and meet the ACRR Technical Safety Requirements (TSR). EA reviewed the pre-operation checklist procedure (ACRR-OP-001), the pulse operation procedure (ACRR-OP-002), and the steady-state operation procedure (ACRR-OP-004), including completed procedures for recently performed operations, and verified that these procedures were adequately reviewed and approved. Although no reactor operations were performed during the review, EA was able to observe pre-operation checks. Procedures generally provide room for operators to make remarks, which both operations management and cognizant system engineers (CSEs) review, and offer an opportunity to communicate pertinent issues for tracking and trending (if not already entered as a condition report for evaluation and corrective action). EA also reviewed operator aids and operations emergency event/ abnormal operating/alarm response procedures (ACRR-OP-008), including the control room logs for the September 28, 2015, entry into fuel element failure actions, and verified the adequacy of operator immediate actions.

EA observed a monthly meeting of the TA-V condition review board and examined several recent condition review board reports to verify that problems are adequately identified and resolved in a timely manner. There were no unplanned reactor scrams in the past year that resulted in condition reports or corrective actions. SNL generally has a timely and effective process for evaluating ACRR incidents, implementing corrective or preventive actions, and trending and determining the extent of condition.

EA reviewed the procedures for plant protection system calibration (ACRR-MP-001), power determination by pool heat up (ACRR-MP-002), and wide range channel calibration (ACRR-MP-012) for the past two annual maintenance activities. The records of surveillance requirements (SRs) are complete and appropriate calibration and quality control processes are in place. The SNL Primary Standards Laboratory (PSL) provides quality calibration services to ensure the accuracy and reliability of measuring and test equipment (M&TE) instruments used for TSR surveillance testing and safety system calibrations. EA reviewed a recent assessment (*Maintenance Management Low Rigor Assessment of PSL Adequacy*, December 2013) that concluded that the PSL processes cover criteria applicable to TA-V nuclear facilities and that TA-V does not need to create and maintain its own M&TE procedure.

EA observed a plan-of-the-week meeting and pre-operation checks and determined that appropriate communication of current issues, conditions, and events had occurred. Reactor startups and pre-operational checks are essentially performed by a single reactor operator and then reviewed by the reactor supervisor. During steady-state power and pulse operations, both the reactor operator and reactor supervisor are required to be present in the control room, and formal conduct-of-operations processes are expected for critical communications. This balancing of formal and informal shift communications at ACRR is acceptable.

Although operations procedures are generally adequate, EA identified a few deficiencies. Procedures generally do not indicate the date of authorization to commence using the procedure, and the documentation for required calibration equipment does not always identify the M&TE models used for traceability. Procedure flowdown listing of TSR requirements is acceptable, but SR acceptance criteria are not always adequately identified or explicitly verified as met/complete during procedure review and approval. However, SR acceptance criteria are implicitly integrated into procedure steps and are being met. SNL has obtained the Institute for Nuclear Power Operations guidance for technical procedure writing, but has not yet incorporated it into their technical writing procedure. (See **OFI-SNL-1.**)

ACRR recently had a reportable event involving degradation of controls established for criticality safety in the high bay. Although this minor event was avoidable, ACRR operators have multiple, complex material handling requirements and procedures to comply with in addition to criticality safety controls, including requirements for fissile material handling, material control and accountability, and classified material handling. ACRR managers are reviewing these requirements to improve implementation. (See **OFI-SNL-2.**)

In conclusion, SNL has adequately established and effectively implemented ACRR facility operations activities, logs, and records. Measured parameters for reactor instrumentation adequately meet TSR parameters. Reactor operators are generally well informed of conditions, properly comply with procedures, and accurately record measured nuclear safety parameters. SNL adequately identifies and resolves problems in a timely manner in accordance with an established corrective action program. EA identified some deficiencies in procedures related to explicit verification of SR acceptance criteria and complexity of material handling requirements.

5.2 Operations – Self-Assessments and Reviews

Criteria:

Managers assess their management processes and identify and correct problems that hinder the organization from achieving its objectives, including monitoring and self-assessment of reactor facility operations. (10 CFR 830.122(i), DOE Order 422.1)

EA reviewed the *TA-V Nuclear Safety Charter* and procedures and schedules for performance of self-assessments, condition reporting and resolutions, incident investigations, and corrective action management. EA also interviewed individuals responsible for performing assessments. Finally, EA reviewed the documentation for a sample of recent self-assessments.

SNL self-assessment procedures are comprehensive and adequately include documented roles and responsibilities, audit credentials and personnel training, scope and assessment planning, analysis, results and reporting. The procedures require an appropriate level of independence for review team members in the reviews. In addition to defining the scope of a planned assessment, the *TA-V Integrated Assessments Procedure* specifically includes expectations that any identified issues outside the direct scope of the assessment are to be documented and tracked for future assessments. The condition reporting and resolution procedure is equally complete.

EA reviewed a sample of self-assessments performed over the previous two years, concentrating on TSR performance and criticality safety. The TSR surveillance assessments were basically crosswalks and checklists to verify that each TSR had established implementing procedures. However, the assessments provided no indication of the adequacy of the procedures to verify the TSR conditions, assessment of the implementation of the procedures or evaluation of the frequency of the use of the procedure.

The evaluation criteria in the criticality safety self-assessments were more specific and provided some context for each line of inquiry, but were documented primarily with “yes” or “no” responses driven by compliance-based questions. In both years’ reviews, the final question addressed the adequacy of controls to ensure that only authorized and trained individuals had access to special nuclear materials. Both assessments indicated that access controls were adequate. However, the recent reportable event for degradation of criticality safety controls in the high bay occurred when an unescorted contract worker who was not trained to handle fissile materials inappropriately moved a fissile materials safe into close proximity to a similar safe. SNL was conducting a causal analysis and was implementing initial corrective actions for this event during the EA review, but this example illustrates a lost opportunity for a self-assessment to identify potential vulnerabilities and initiate preventative actions before an event occurs. Although generally complete from a procedural perspective, the self-assessment process based on checklist-driven verifications of flowdown of requirements to the specific area of review does not fully evaluate all of the important performance aspects of a program or review area. (See **OFI-SNL-3**.)

In conclusion, SNL has established generally adequate self-assessment and review processes for assuring compliance, but additional performance-based criteria and evaluations could be more effective in identifying and preventing problems before they happen. The corrective action program is generally well established and effectively implemented.

5.3 Training and Qualification – Operator Certification and Continuing Training

Criteria:

Reactor operators, senior reactor operators, and fuel handlers (or fissionable material handlers) at Hazard Category 1 and 2 nuclear reactor facilities are trained and certified to be capable of performing their assigned work. Training for reactor operators and senior reactor operators includes formal

classroom-type and on-the-job training to ensure familiarity with all required aspects of reactor operation, including anticipated transients and accident conditions, and written examinations are administered to candidates for certification. Continuing training is provided to personnel to maintain their job proficiency. Continuing training programs for certified operators and supervisors consist of preplanned classroom-type training, on-the-job training, and operational evaluations on a regular and continuing basis. (10 CFR 830.122(b), DOE Order 426.2)

The SNL *TA-V Nuclear Facility Training Implementation Matrix (TIM)* identifies applicable requirements from DOE Order 426.2 for training, qualification, certification, continuing training, and recertification for ACRR reactor operators, reactor supervisors (SNL designation for senior reactor operator), and fissile material handlers. The TIM refers to the *TA-V Training Program Manual for Nuclear Facility Requirements* and facility-specific procedures for implementing DOE Order 426.2 requirements related to training, qualification, certification, and recertification of required positions.

EA reviewed the *ACRR Facility Operations Staff Training and Certification Requirements* document, referred to as the ACRR training and qualification (T&Q) program document in this report. This document includes specific requirements for formal classroom training, on-the-job training (OJT) topics and practical factors, operational performance evaluation requirements, written final examination, final operational evaluation, and final oral board evaluation. The ACRR T&Q program document appropriately captures DOE Order 426.2 requirements for each of these components and in one case exceeds requirements for a Category B reactor. Specifically, DOE Order 426.2 allows combining the final operational evaluation and oral board into one final activity for a Category B reactor facility; however, the ACRR T&Q program requires both a final operational evaluation and a final oral board for initial qualification, thereby providing additional rigor to the program.

EA reviewed completed quizzes and examinations for formal classroom training, lessons plans, and completed final evaluation board questions and candidate responses. Lesson plan learning objectives were covered in the training materials, the classroom quizzes and final board questions covered required topics, and candidate responses were sufficiently documented. For certified positions, SNL management completed and appropriately documented required medical examinations and certifications. In completed examinations, required topics were covered and the tests were appropriately controlled and updated as necessary. Written examinations covered required topics applicable to the ACRR and included topics required by continuing training.

EA observed a certified reactor operator performing the daily reactor pre-operation checks procedure, including completion of required daily surveillance tests, and noted that the operator was highly competent and demonstrated the knowledge and skills to safely operate the reactor and its safety systems. Overall, SNL's effective operator qualification and certification process has resulted in highly competent ACRR reactor operators and reactor supervisors.

SNL completed a position-specific tabletop job analysis (TTJA) for the reactor operator and reactor supervisor positions as the first step in the systematic approach to training (SAT). The TTJA adequately identifies specific tasks for each of the certified positions, whether training is needed, and the type of training (i.e., formal classroom, OJT, or continuing training). SNL effectively used the results of the TTJA to develop the specific content for each component of the training program identified in the ACRR T&Q program document, such as the OJT checklist requirements.

DOE Order 426.2 also contains lists of required classroom training for initial training and qualification of operators, as well as required operational performance evaluations. These topics are required to be included, as applicable, to the specific position requirements derived from the application of the SAT. EA sampled some of these required training topics to determine whether they were addressed in the

ACRR specific training and qualification procedure. In some cases it was not readily apparent how some topics were addressed because the title of the training topic was different than in the Order and the topics were grouped differently since they were based on the results of the TTJA. During discussions with training and operations staff, EA was able to determine that the formal training topics and operational performance evaluations listed in the Order are adequately included in the ACRR T&Q program document. However, SNL personnel had not clearly documented how they evaluated and incorporated the required training topics from DOE Order 426.2 into the facility-specific operator T&Q program. (See **OFI-SNL-4**.) SNL has recently purchased VISION, an industry leading software package, for documenting the SAT and providing configuration control of training materials. This software could aid in developing the crosswalk for formal training topics to the specific course content that addresses the required topics.

For continuing training and recertification, the ACRR T&Q program document adequately identifies applicable training topics, proficiency requirements, emergency program drills, and medical examinations to be covered during the two-year requalification period. Expiration dates on recertification documentation reviewed by EA were clearly identified, and required continuing training, including training on emergency and abnormal operating procedures (AOPs), was completed. The ACRR T&Q program document also includes DOE Order 426.2 requirements for the recertification of operators after disqualification for not maintaining active duty status, unsatisfactory personal performance, failed examination, or failure to meet medical requirements. ACRR has never had to recertify an operator because of one of these conditions.

SNL requires each operator to complete an operational evaluation of an emergency drill and classroom training and examination on AOPs once during the two-year recertification period. However, Section 7, *Continuing Training*, paragraph b. (1) of Attachment I to DOE Order 426.2 states that “Training and examination covering abnormal facility procedures and emergencies must be provided annually.” (See **OFI-SNL-5**.) Although ACRR has about 20 AOPs, the two most important operator immediate actions – to scram the reactor and notify management – were included in all of them. Additionally, although formal training on AOPs was conducted only once during the two-year continuing training cycle, operators referred to and used the AOPs in some recent situations, and showed that they are sufficiently proficient in the content and use of the AOPs.

SNL recently conducted a triennial training program assessment as required by DOE Order 426.2. SNL appropriately covered all of the required topics in DOE-STD-1070, *Guidelines for Evaluation of Nuclear Facility Training Programs*, in the report, and the review was sufficiently rigorous. For example, the report self-identified the following issues that could adversely impact operator certification and continuing training if not properly evaluated and corrected:

- Initial qualification, continuous evaluation, and development of TA-V instructors and OJT evaluators lack formality to ensure repeated high quality instruction.
- Existing processes to ensure that training materials are maintained current and accurate are not fully effective.

EA discussed the planned corrective actions to address these issues with the SNL TA-V training management and staff. Although formal corrective actions had not yet been developed, the training staff had initiated some initial and longer-term actions to address these issues. (See also **OFI-SNL-4**.)

In conclusion, SNL has developed and implemented an effective initial operator training, qualification, and certification program that meets and in some cases exceeds applicable DOE requirements and results in highly competent reactor operators and supervisors. SNL has also conducted required program self-assessments and identified some deficiencies to be evaluated and corrected as part of the contractor assurance system (CAS). EA noted some isolated deficiencies in documenting the evaluation of required

training topics when developing position-specific training requirements, and in the periodicity of continuing training on AOPs.

5.4 Safety Basis – Surveillances and LCOs

Criteria:

Technical safety requirements are developed that are derived from the documented safety analysis to ensure that the necessary operability and quality of safety structures, systems, and components is maintained; that reactor operations are within safety limits; and that limiting control settings and limiting conditions for operation are met. (10 CFR 830.205(a))

SNL adequately describes TSR LCOs and SRs and their technical bases, consistent with the documented safety analysis (DSA), and surveillance testing is acceptably conducted. As previously discussed, EA reviewed several completed surveillance test procedures for annual calibrations, verified that they were acceptably conducted, verified that the M&TE was appropriate and acceptably calibrated, and verified that applicable as-built system design documents and supporting documents are kept current using formal change control processes. The TA-V configuration management (CM) tool (CM Tool), Enterprise Bridge (eB), is a strength and keeps all ACRR system design documents and supporting documents current in real time using formal change control processes. As described in the *TA-V Configuration Management Plan*, the CM Tool is a comprehensive data system that not only maintains system design documentation, but also maintains current safety SSC CM application and CSE designation listings for each TA-V nuclear facility, as well as the TA-V master equipment list database.

TSR LCOs and SRs are intended to adequately maintain safety SSCs and ensure that reactor operations are within safety limits. EA reviewed the DSA Chapter 15 descriptions of safety controls and their flowdown into the TSRs and implementing procedures for safety-significant controls. There are safety limits for maximum steady state reactor power, pulse reactivity insertion, and peak fuel temperature, and there are no safety-class SSCs or controls. SNL maintains a crosswalk spreadsheet of LCOs and SRs, their required frequency, and their compliance document(s), which EA found helpful for this review. ACRR surveillances are performed either annually (every January) or daily prior to operations; this approach is simple and easily tracked to ensure that no SRs are missed. LCO entries, although rare, are adequately tracked in control room logs and ACRR operations updates. Operators demonstrated during interviews that they are generally well-trained and knowledgeable of the LCOs and SRs, and they routinely interact with engineering on unreviewed safety question determinations, system modifications, implementation verification reviews, and DSA annual updates.

Based on interviews and review of a sample of documents, the CSEs effectively support operations and maintenance activities related to their assigned systems, routinely interact with reactor operators and safety basis engineers, and perform periodic system health monitoring and trending. EA discussed system health monitoring with the CSEs and reviewed several system health reports. The system health reports are prepared quarterly, and the summary reports provide performance metrics for system operability, reliability, and material condition, as well as summary notes and tracking of current condition reports. Instead of scheduled system assessments, each quarter a different safety system is assessed more comprehensively in the full system health report. Such assessments include corrective actions, facility work packages, modification packages, engineering evaluations, operability assessments, engineering evaluations, and performance monitoring and trending. SNL has established an effective system engineering program and CSE T&Q program that complies with DOE Orders 420.1 and 426.2. Overall, the CSEs demonstrate acceptable knowledge and ownership of their systems to ensure the operability and quality of safety SSCs.

EA reviewed a sample of CM program documentation that was generally adequate but identified one

deficiency. SNL issued the system design description (SDD) for the reactor safety system in 2013 and has not updated it annually as required by *TA-V System Design Descriptions*. This initial issue of a single, consolidated SDD, superseding four separate SDDs, more accurately reflected the primary design standard of record, but it omitted an important rod control modification project implemented in 2013 and has not been updated. However, SNL is keeping all system design information current in the CM Tool, and the SDD itself (as a single physical or electronic document) is not a primary source document for any technical activities. Still, approved changes are not being incorporated into the SDD as a controlled document in a timely manner. (See **OFI-SNL-6**.)

In conclusion, ACRR surveillances and LCOs effectively maintain the operability and quality of safety SSCs within safety limits. Reactor operators and CSEs are experienced and knowledgeable, and they have developed an effective working relationship between operations and engineering to ensure nuclear safety requirements are met. Although the TA-V CM Tool is a strength in keeping system design documents current, EA identified a deficiency in that SNL has not updated the reactor safety system SDD in a timely manner.

5.5 Safety Basis – Experiments

Criteria:

Experiments are reviewed according to a DOE approved unreviewed safety question process. (10 CFR 830.203(d)(3))

EA observed radiological control technician (RCT) startup rounds, reviewed procedures for experiment-specific hazard analysis and control, interviewed personnel involved with experiment approvals and planning, and reviewed a sample of experiment safety plans and radiological technical work documents (RTWDs). SNL uses a hazard analysis and review process (i.e., primary hazard screening and RTWDs) to ensure experiments are analyzed and controls are established.

The principal procedure for ensuring conformance to the safety basis and technical specification requirements for experiment review (ACRR-MP-020) is primarily driven by the DSA hazard analysis for risks to members of the public at the fence line for SNL. Consequently, the major limitations and controls are based on material-at-risk restrictions determined by plutonium (Pu)-239 dose equivalents for alpha-emitting isotopes, or for tritium uptakes in a release plume. The procedure also includes limitations on explosive materials, measurement of experiment reactivity worth, experiment neutron fluence for both steady state and pulse operations, and estimates of induced heating. While this procedure adequately addresses protection against catastrophic reactor damage and potential offsite consequences, it does not fully address hazard analysis and controls for co-located workers or facility workers. Further, the procedure contained some inaccurate references for Pu-239 equivalence conversions. (See **OFI-SNL-7**.)

While the use of Pu-239 equivalence as a control is appropriate for offsite dose assessment, it is not fully applicable to the hazards encountered by facility workers who would additionally be exposed to activation product external radiation hazards or potential for activation product isotope uptake processes that are not included in the equivalence tables. Currently, typical controls for irradiated components are based on historical experience with similar experiments and RCT external dose rate measurements at the time of experiment handling. SNL procedures do not require pre-experiment calculation of potential activation or implementation of isotope-specific material handling controls following the activation of experiment targets. SNL does not maintain an isotope-based inventory for irradiated experiment targets. This approach does not address isotope-specific considerations such as decay time, beta contact dose, or uptake issues that could be important for an unexpected off-normal condition or incident response. Additionally, isotope-specific values are required for determination of transport or clearance of irradiated components. Currently, these are determined by direct measurements with gamma spectrum analysis at the time of

disposition without a complementary activation calculation. This presents the potential for hard-to-detect isotopes such as low energy x-ray or pure beta emitters to be missed. (See **OFI-SNL-8.**)

Although the experiment safety procedure (ACRR-MP-020) does not specifically address all facility worker hazard analyses, separate corporate SNL processes for preliminary hazards screening provide a more holistic approach to the hazards that facility workers are most likely to encounter. These include not only radiological hazards, but also other toxicological, chemical, energy source, and industrial hazards. In the SNL corporate process, each proposed experiment or class of experiments is reviewed by a team consisting of appropriate subject matter experts of the Sandia Independent Review and Appraisal System as well as facility operators and experimenters, using a system for primary hazard screening as implemented through an experiment safety plan form. The results of the facility- and experiment-specific review and approval processes include issuance of adequate control documents, such as the RTWD or similar control procedures. These are supported by a variety of internal TA-V procedures for material handling and storage (ACRR-MP-007), fissile material tracking and record keeping (ACRR-MP-016), and others. These in turn are supported by safety management programs (SMPs), such as the radiation protection program and the maintenance and surveillance programs.

As implemented, these SNL processes are generally sufficient to ensure experiment safety for members of the public, co-located workers, and facility workers. However, these processes rely heavily on expert-based knowledge and past performance of similar experiments to ensure that hazards are recognized and appropriate controls are implemented. The variety of review and control processes for different experiments is complicated, so multiple documents could be referred to for implementing controls. From a document auditing perspective, the complexity of these processes and their bases in multiple separate procedures and expert knowledge may result in missing important changes in experiment envelopes or specific hazards, or implementing inappropriate controls at the operational level. Personnel changes in the expert base could exacerbate this potential risk. (See **OFI-SNL-9.**)

EA observed the RCT startup rounds, which follow a fairly simple process of examining the area radiation monitor readouts and check source functionality tests for various radiation detection and personnel contamination monitors. RCTs complete check sheets after their rounds. The simple check sheet provides no condition-specific data other than checking that an item and conditions were acceptable. The RCT was experienced and knowledgeable of expected conditions; however, the check sheet provided no guidance on the acceptable ranges or conditions. As implemented, the check sheet does not provide a context for the results to help identify off-normal conditions. The data cannot be used to assess or trend changes in conditions or evaluate the impacts of various operations. Consequently, without specific data, the sheets do not provide an operational benefit by assisting with identification and understanding of the causes of trends or recognizing and responding off-normal conditions. (See **OFI-SNL-10.**)

During observation of RCT rounds, one of the area monitors was reading significantly higher than all the others. The RCT identified this discrepancy as resulting from a posted high radiation area condition in an adjacent storage area. The entrance to that area was not controlled via physical controls. The high radiation area condition was less than 1 R/hr, which is acceptable; however, under some conditions, stored experiment components may exceed that level. Current controls use a combination of physical indicators (a switched-on red beacon) and administrative controls (requiring an individual to inform the RCT prior to entry). Under potential conditions where the dose rate could exceed 1 R/hr at 30 cm, these controls would not satisfy 10 CFR 835.502 requirements that specify physical controls for access. (See **OFI-SNL-11.**)

In conclusion, SNL has established an adequate set of hazard evaluation processes for ACRR experiments. SNL has implemented controls sufficient to ensure the safety of members of the public and conformance to TSR safety limitations. SNL has also implemented processes for monitoring and

controlling hazards to facility workers and for controlling and clearing irradiated experiment components. However, improvements in some specific practices and procedures could strengthen SNL's processes and better ensure safety for any off-normal or unexpected conditions that may not be representative of past experience.

5.6 DOE Field Element Oversight

Criteria:

DOE field element line management has established and implemented effective oversight processes that evaluate the adequacy and effectiveness of reactor facility operations. (DOE O 226.1B, DOE Order 422.1)

The SFO oversight process includes the development of a *Fiscal Year Oversight Plan and Schedule* for the SFO Office of Engineering that describes SFO's approach to oversight of the SNL TA-V nuclear facilities. The oversight plan identifies applicable SMPs requiring oversight and a determination of the level of oversight for each SMP based on a qualitative evaluation of performance in each of the applicable functional areas, such as conduct of operations (CONOPS). The end product is a schedule of oversight activities, including planned operational awareness activities (OAAs) and assessments for each SMP. The SFO 2015 oversight plan and schedule followed the guidance in the NNSA supplemental directive on line oversight (NA-1 SD 226.1A) and provided a sound basis for the scope, type, and level of oversight activities at the ACRR based on program performance. However, SNL CAS performance and risk is not fully considered during development of the oversight plan in accordance with related guidance in DOE Guide 226.1-2B, *Federal Line Management Oversight of DOE Nuclear Facilities*. As a result, consideration of SNL CAS performance is not fully described in the annual integrated oversight plan for TA-V. (See **OFI-SFO-1**.)

SFO has one assigned Facility Representative (FR) and one safety system oversight (SSO) representative for ACRR and all of the other TA-V nuclear facilities (i.e., the Sandia Pulsed Reactor/Critical Experiments Facility and the Auxiliary Hot Cell Facility), based on the latest staffing analysis completed in early 2014. The FR is currently qualified (due for requalification in summer 2016), and the SSO representative recently completed qualification in the DOE Instrumentation and Control Functional Area Qualification Standard and site-specific systems for TA-V. Completed and planned FR OAAs show that FR oversight of ACRR appropriately focuses on key aspects of CONOPS and implementation verification reviews of TSRs. During a walkthrough with the FR and SSO representative, the FR was knowledgeable of the ACRR operations, the TSRs, and the current facility configuration and operational limitations. The SSO representative was knowledgeable of assigned systems, current engineering safety health reports, current system deficiencies, and planned upgrades to the reactor rod control system.

SFO has developed effective OAA checklists for periodic/routine FR activities, such as daily operations checks, fact finding/critiques, and evaluating some aspects of CONOPS. Based on discussions with the FR, SFO intends to expand the use of these checklists to additional aspects of CONOPS and other program areas.

Before the EA review, SFO conducted a self-assessment based on EA CRAD 31-08, indicating that SFO values and emphasizes organizational learning and the supporting attribute of performance monitoring through multiple means. However, EA noted that one issue – FR not reviewing final occurrence report corrective actions in a timely manner – was a repeat issue from a previous self-assessment completed in July 2014. Additionally, based on discussions with SFO management, many corrective actions to address findings and weaknesses identified in the July 2014 self-assessment had not been completed; effective resolution of reported problems is an important attribute of a healthy/strong safety culture

The SFO self-assessment based on the EA CRAD also identified that several SMP assessments and assessments of CONOPS and TSR implementation in the 2015 oversight plan had not been completed as scheduled. Discussions with SFO management indicated that although OAAs were conducted for some SMPs, SFO had not conducted planned assessments of some SMPs and the FR had not conducted scheduled assessments of quarterly/annual surveillances and some elements of CONOPS. Additionally, this SFO self-assessment noted that although the FR staffing analysis was completed within the required two-year period, it had not been updated to reflect a doubling in ACRR yearly operations from the previous FR analysis. SFO has identified some potential solutions for increasing FR coverage, such as cross-training the SSO staff member to provide additional support to the FR, and requalifying the current FR for all the TA-V nuclear facilities instead of just the ACRR. However, these actions do not provide sufficient backup for the single FR. (See **OFI-SFO-2.**)

During this EA review, SFO was still evaluating the recent self-assessment results through its issues management process, so EA could not fully evaluate SFO's corrective actions to address the overdue SMP assessments. In general, SFO is not periodically reviewing and updating the oversight plan to reschedule planned assessments as necessary. (See **OFI-SFO-3.**)

In conclusion, the SFO oversight process provides a sound basis for identifying the scope, type, and level of oversight activities at the ACRR and other TA-V nuclear facilities based on program performance. The assigned FR and SSO representative are knowledgeable of the status of ACRR operations and systems and conduct routine oversight activities to provide assurance that ACRR is being operated safely. SFO's evaluation and correction of self-identified weaknesses related to implementation of oversight activities have helped ensure the continued effectiveness of DOE line management oversight of SNL's operation of the ACRR. EA also identified some deficiencies related to FR oversight support, oversight planning, and periodic evaluation of oversight-related data.

6.0 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. Findings define the specific nature of the deficiency, whether it is localized or indicative of a systemic problem, and identify which organization is responsible for corrective actions. Findings may identify aspects of a program that do not meet the intent of DOE policy or Federal regulation. DOE line management and/or contractor organizations must develop and implement corrective action plans for EA appraisal findings. Cognizant DOE managers must use site- and program-specific issues management processes and systems developed in accordance with DOE Order 227.1 to manage these corrective action plans and track them to completion. The results section of this report also identifies deficiencies including isolated non-compliances that did not meet the criteria for a finding. Site processes should be consulted in response to these deficiencies.

EA identified no findings for SNL or SFO during this review.

7.0 OPPORTUNITIES FOR IMPROVEMENT

Opportunities for improvement are suggestions offered in EA appraisal reports that may assist cognizant managers in improving programs and operations. OFIs may also address other conditions observed during the appraisal process. EA provides OFIs only as recommendations for line management consideration; OFIs do not require formal resolution by management through a corrective action process. These potential enhancements 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 conduct of the review. In some cases, OFIs address areas where program or process improvements can be achieved through minimal effort.

Sandia National Laboratories

OFI-SNL-1: SNL should consider updating the *TA-V Technical Writing Procedure* and revising ACRR procedures accordingly, specifically to ensure that TSR SR acceptance criteria are clearly identified and verified as complete during procedure review and approval.

OFI-SNL-2: SNL should consider updating its multiple material handling requirements and procedures for the ACRR high bay to reduce unnecessary conservatisms and complexity.

OFI-SNL-3: SNL should consider conducting more performance-based self-assessments instead of relying on crosswalks and checklists.

OFI-SNL-4: SNL should consider expanding the position-specific task to training matrix as part of the TTJA to indicate how the identified training is conducted (classroom, required reading, OJT, etc.) and to show how the required topics in DOE Order 426.2 are addressed or provide a basis for why they are not required for the position.

OFI-SNL-5: SNL should consider conducting continuing training/drills on emergency event/abnormal operating procedures annually in accordance with DOE Order 426.2.

OFI-SNL-6: SNL should ensure that the reactor safety system SDD is updated annually and/or update the *TA-V System Design Descriptions* to accurately describe SDD maintenance and change control expectations.

OFI-SNL-7: SNL should consider reviewing and updating procedures (e.g., ACRR-MP-020), specifically to ensure accuracy of references for application of Pu-239 equivalent conversion factors.

OFI-SNL-8: SNL should consider using experiment-specific isotope activation and dose rate calculations or estimates in the experiment safety reviews to clearly identify isotope-specific hazard controls and off-normal condition responses to address post-irradiation radionuclide hazards for facility workers and co-located workers. Similarly, SNL should consider maintaining/tracking radionuclide-based activated material inventories to assist in handling, storage, and disposition.

OFI-SNL-9: SNL should consider streamlining the documentation of hazard analysis and controls for experiments.

OFI-SNL-10: SNL should consider modifying RCT rounds documentation to incorporate data collection for trending and to provide guidance on acceptable/anticipated readings or responses.

OFI-SNL-11: SNL should upgrade administrative controls to physical controls for high radiation conditions that may exceed 1R/hr when applicable, in accordance with 10 CFR 835.502.

Sandia Field Office

OFI-SFO-1: SFO should consider incorporating applicable guidance in DOE Guide 226.1-2B in developing its annual integrated oversight plan for TA-V.

OFI-SFO-2: SFO should consider options to increase the support to the single assigned FR at TA-V.

OFI-SFO-3: SFO should consider instituting a periodic review (e.g., quarterly) and analysis of all sources of oversight data to provide a formal mechanism and basis for adjusting scheduled oversight activities as needed.

Appendix A Supplemental Information

Dates of Review

Onsite Review: November 16-20, 2015

Office of Enterprise Assessments (EA) Management

Glenn S. Podonsky, Director, Office of Enterprise Assessments
William A. Eckroade, Deputy Director, Office of Enterprise Assessments
Thomas R. Staker, Director, Office of Environment, Safety and Health Assessments
William E. Miller, Director, Office of Nuclear Safety and Environmental Assessments
Patricia Williams, Director, Office of Worker Safety and Health Assessments
Gerald M. McAteer, Director, Office of Emergency Management Assessments

Quality Review Board

William A. Eckroade
John S. Boulden III
Thomas R. Staker
Gerald M. McAteer

EA Site Lead for Sandia National Laboratories

Timothy F. Mengers

EA Reviewers

William A. Macon, Jr. – Lead
Albert E. MacDougall
Timothy F. Mengers

Appendix B Key Documents Reviewed, Interviews, and Observations

Documents Reviewed (relevant to the OFIs and report conclusions)

- *2015 Triennial Training Program Assessment Final Report*, Rev. 1, 6/2015
- *ACRRF Operations Response Procedure Training Module D-2*, 9/2014
- *ACRR Facility Operations Staff Training and Certification Requirements*, Rev. 9, 3/7/2014
- *ACRR LCO Surveillance Procedure Crosswalk*, spreadsheet provided for the review
- *ACRR Table Top Job Analysis*, Rev. 2, 8/2011
- *ACRR-MP-001, PPS Calibration Procedure*, Rev. 4, 1/7/2015
- *ACRR-MP-002, Power Determination By Pool Heat Up*, Rev. 1, 5/2013
- *ACRR-MP-012, Wide Range Channel Calibration*, Rev. 1, 8/2009
- *ACRR-MP-020, Experiment Safety*, Rev. 5, 7/16/2015
- *ACRR-OP-001, Pre-Operation Checklist*, Rev. 11, 7/2015
- *ACRR-OP-002, Pulse Operation*, Rev. 8, 7/2015
- *ACRR-OP-004, Steady-State Operation*, Rev. 6, 7/2015
- *ACRR-OP-008, Operations Emergency Event/Abnormal Operations/Alarm Response Procedures*, Rev. 7, 7/16/2015
- *AP-003.00, TA-V Operational Drill Program*, Rev. 9, 9/2009
- *ASRP-ENG-8.16.2013-529566, Sandia Field Office Facility Representative Staffing Analysis Report*, 1/2014
- *Cross-Walk DOE O 426.2 to ACRR Training and Certification Procedure Comprehensive Examination Content*, developed and provided during the review
- *Final Report for the Sandia Field Office Self-Assessment of Nuclear Safety Performance*, 7/2014
- *Maintenance Management Low Rigor Assessment of PSL Adequacy Final Report*, 12/2013
- *NA-1 SD 226.1A, NNSA Line Oversight and Contractor Assurance System Supplemental Directive*, 10/17/2008
- *Operational Awareness Activities at TA-V*, from SFO oversight database (ePegasus printout)
- *Reactor Safety System SDD*, Rev. 0, 6/2013
- *Sandia Site Office Crosscutting Procedure Nuclear Safety Management Program Assessment*, Rev. 0, 10/2012
- *Sandia Site Office Nuclear Operations Procedure, Appendix A, ACRR Operations Compliance Verification Assessment Guide*, Rev. 1, 1/2011
- *Sandia Field Office Fiscal Year 2015 Oversight and Schedule for the Office of Engineering*, Rev. 0, 11/2014
- *Sandia Field Office Self-Assessment of Nuclear Oversight Program*, 11/10/15, draft summary of results
- *System Engineer Training and Qualification Program*, Rev. 1, 10/1/2014
- *System Health Report*, Q3/2015
- *TAV-AP-011, System Walkdowns and System Health*, Rev. 1, 8/1/2009
- *TAV-PD-002.3, TA-V Nuclear Safety Management Program*, Rev. 0, 12/2009
- *TAV-PPL-003, System Engineering Program*, Rev. 1, 7/19/2010
- *TA-V Configuration Management Program Plan*, Rev. 4, 11/16/2015
- *TA-V Nuclear Facility Training Implementation Matrix (TIM)*, Rev. 10, 5/2011
- *TA-V Nuclear Safety Charter for the ACRR, SPRC, and the RCSC*, Rev. 2, 10/15/2013
- *TA-V System Design Descriptions*, Rev. 2, 6/27/2013
- *TA-V Technical Writing Procedure*, Rev. 0, 3/31/2015

- *TA-V Training Program Manual for Nuclear Facility Requirements, Rev. 1, 12/13/2011*

Interviews

- SNL ACRR Facility Supervisor
- SNL ACRR Manager
- SNL ACRR Reactor Operator (1)
- SNL ACRR Reactor Supervisor (1)
- SNL Cognizant System Engineers (3)
- SNL Engineering Manager
- SNL Experiments Manager
- SNL Nuclear Facility Training Coordinator
- SNL Nuclear Facility Training Manager/Safety Basis Manager
- SNL TA-V Radiation Control Manager
- SFO Acting Engineering Manager
- SFO Facility Representative (1)
- SFO Nuclear Facility Training Program Subject Matter Expert
- SFO Safety System Oversight Representative (1)

Observations

- TA-V plan of the week meeting
- ACRR plan of the week meeting
- TA-V condition review board meeting
- ACRR pre-operation checks (ACRR-OP-001)
- ACRRF walkthrough with FR and SSO
- Engineering demonstration of TA-V CM Tool (eB)