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**DEFENSE NUCLEAR FACILITIES
SAFETY BOARD**

Washington, DC 20004-2901



December 16, 2022

The Honorable Jill Hruby
Administrator
National Nuclear Security Administration
US Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585-1000

Dear Administrator Hruby:

The Defense Nuclear Facilities Safety Board (Board) completed a review of conduct of operations in Technical Area V at Sandia National Laboratories (SNL). The review included operations associated with in-service inspection of reactor fuel elements in the Annular Core Research Reactor Facility (ACRRF) and addressed five recent off-normal lifting events at the facility.

The Board recognized some improvements in the safe conduct of operations at ACRRF when compared to the results of prior reviews; however, conduct of operations at ACRRF continues to lack the formality and rigor required for sustained, high-level safety performance. In addition, the Board noted continuing safety oversight challenges associated with lifting operations at ACRRF based on the ineffectiveness of corrective actions to prevent recurrence of past events. Sandia Field Office and SNL senior management are monitoring corrective actions to address the off-normal lifting events at ACRRF.

The enclosure contains additional details on the review and is intended to provide the National Nuclear Security Administration and SNL with additional information to use going forward as work progresses to improve ACRRF safety management programs.

Sincerely,

Joyce L. Connery
Chair

Enclosure

c: Mr. Joe Olencz

DEFENSE NUCLEAR FACILITIES SAFETY BOARD
Staff Report

November 23, 2022

Conduct of Operations at Sandia National Laboratories Technical Area V

Background. A Defense Nuclear Facilities Safety Board (Board) review team conducted a review of conduct of operations and conduct of maintenance at Technical Area V (TA-V) at Sandia National Laboratories (SNL) in 2014. The review team concluded that Sandia Field Office (SFO) oversight and SNL self-assessments did not meet the safety expectations in Department of Energy (DOE) directives and SNL guidance documents. In addition, significant SNL management attention was needed to improve the conduct of operations governance documents, rigor and formality of operations and maintenance activities, and safety oversight and assessments. While the review team identified no imminent safety concerns, the Board wrote a letter to the Administrator of the National Nuclear Security Administration (NNSA) that highlighted the review team's observations and provided a staff issue report for NNSA and SNL to use in pursuing opportunities to improve SNL safety management programs.

In 2016, a Board review team completed a follow-up review at TA-V noting numerous safety deficiencies and opportunities for improvement in the TA-V conduct of operations and maintenance programs. Many of these deficiencies and opportunities for improvement were the type that should normally be identified during periodic and rigorous SNL self-assessments and SFO safety oversight activities. The review team concluded SFO safety oversight and SNL self-assessments of conduct of operations and maintenance programs were still not meeting the expectations outlined in DOE directives and contractor guidance documents.

As part of the startup activities for the new reactivity control system upgrade (RCSU) at the Annular Core Research Reactor Facility (ACRRF), NNSA completed a federal readiness assessment (FRA) prior to approving the operation of RCSU in 2018. The FRA found that TA-V did not rigorously follow its approved engineering/configuration management processes during the project. The FRA report required that both a senior supervisory watch and a conduct of operations advisor observe the initial operations of RCSU. The FRA requirement for conduct of operations oversight reflected continuing challenges with the formality and rigor of conduct of operations at ACRRF.

Discussion. Members of the Board's staff completed a follow-up review of conduct of operations at TA-V in 2022. A conduct of operations program consists of formal documentation and practices that implement disciplined and structured operations that support mission success and promote worker, public, and environmental protection. The program's goal is to minimize the likelihood and consequences of human error or technical and organizational system failures. It supports safety and mission success for a wide range of hazardous, complex, or mission-critical operations. Failure to properly implement the program requirements can result in significant damage to equipment or personnel injury or death. Therefore, contractors are responsible for implementation of the conduct of operations program requirements and must comply with those requirements as set forth by DOE directives. This review evaluated the

adequacy of the requirements and implementation of the conduct of operations program at TA-V to ensure safety of equipment and personnel.

The review team observed operations associated with the in-service inspection of reactor fuel elements in the ACRRF and the inspection of unirradiated fuel elements in the Auxiliary Hot Cell Facility (AHCF). The review team also observed the FRA for the restart of Fueled-Ring External Cavity – Version II (FREC-II) operations at ACRRF. In addition, the review team evaluated documents, videos of operations, causal analyses, and corrective action reports, and observed additional startup activities to understand and evaluate conduct of operations at TA-V. The review team focused on development and implementation of the necessary procedures and administrative controls to ensure compliance with the technical safety requirements and limiting conditions for operation at TA-V. National Technology and Engineering Solutions of Sandia, LLC (NTESS) experienced three hoisting and rigging off-normal lifting events at ACRRF in the two years preceding the review. During the review, two additional hoisting and rigging events occurred at ACRRF, leading the review team to add a hoisting and rigging objective to the review plan to evaluate NTESS and SFO responses to these events.

Conclusion. The review team did not identify any imminent safety concerns. However, while some improvements in the safe conduct of operations were noted when compared to the results of prior reviews, conduct of operations at ACRRF continues to lack the formality and rigor required for sustained, high-level safety performance. In particular, continuing challenges remain associated with the safety of hoisting and rigging operations at ACRRF based on the ineffectiveness of corrective actions to address the five lifting events that occurred there over the past 2-1/2 years. In addition, the working environment is such that operators do not recognize the importance of performing procedures as written. Instead of consistently stopping work to correct unworkable procedures, ACRRF staff on several occasions inappropriately used work arounds or selectively interpreted procedures to allow work to continue.

The review team identified six functional areas for potential improvement in formality and rigor for the conduct of operations safety management program at TA-V, including (1) pre-job briefings, (2) procedure development and classification, (3) formality and rigor of operations, (4) radiological contamination control, (5) hoisting and rigging, and (6) organization and administration. Detailed observations supporting the review team's conclusions are provided in the Appendix to this report.

Appendix

Review Team Observations

Review Team Observations. The review team conducted interviews with the Technical Area V (TA-V) senior manager; the managers, supervisors, operators, technicians, and procedure writers for the Annular Core Research Reactor Facility (ACRRF); and the managers, supervisors, operators, technicians, and procedure writers for Auxiliary Hot Cell Facility (AHCF). The review team also interviewed the TA-V radiation protection staff and managers. The review team's observations are grouped below into six functional areas: (1) pre-job briefing, (2) procedure development and classification, (3) formality and rigor of operations, (4) radiological contamination control, (5) hoisting and rigging, and (6) organization and administration. Appendix A of this report provides additional review team observations and comments.

Pre-job Briefing—A pre-job brief is a process by which the person-in-charge interfaces with workers as they are assigned work activities. During a pre-job brief, the person-in-charge discusses with the workers the critical steps, hazards, controls, tools, equipment, and techniques to be used, including stop work authority. Failure to accomplish these required elements can result in unclear work scope and unsafe work execution. The review team evaluated the ACRRF and AHCF facility supervisors' pre-job briefing materials and found that these materials did not address all of the requirements of Department of Energy (DOE) Order 422.1, *Conduct of Operations*, Attachment 2, Appendix A, Paragraph 2.1, "Turnover and Assumption of Responsibilities" [1] and TAV-AP-008, *Activity Level Work Planning & Control Procedure* [2], and the guidance provided in DOE Handbook 1211-2014, *Activity-Level Work Planning and Control Implementation*, Section 6.6.2, "Pre-Job Brief" [3]. Specifically, TAV-AP-008 [2] states that a "pre-job brief can be informal (non-documented) or formal (documented)." The procedure does not describe any differences in content or frequency of the two types of briefings other than whether they are to be documented and does not include conditions under which each type of briefing should be used.

TAV-AP-008 [2] directs that formal pre-job briefings use Sandia Form SF 2001-PJC, *Pre-Job Briefing Form* [4], or equivalent, and maintain it as a record. However, the review team found that the pre-job briefing form developed by the AHCF facility supervisor is not equivalent to the Sandia Corporate checklist and is not maintained as a formal record. For example, the AHCF form does not cover personnel assignments, factors affecting human performance, and other job requirements covered in the Sandia Corporate checklist. In addition, operators performing the fuel handling and storage procedure at ACRRF (ACRR-MP-005) [5] did not complete a pre-job briefing roster. Additionally, the review team found that the pre-job brief templates developed by the AHCF and ACRRF facility supervisors are not part of a formal document control system.

Procedure Development and Classification—The review team identified several concerns and opportunities for improvement in procedure development related to procedure quality and classification of procedures (reference, multiple use, or continuous use).

- **Quality of Procedures:** Procedures are written to safely perform a wide range of hazardous, complex, or mission critical operations. Failure to develop quality, workable procedures results in work stoppage or operator execution of work without compliance to safety requirements. Some operations procedures did not comply with DOE Order 422.1 [1] requirements as implemented by the *Document Lifecycle Management Procedure* [6] which requires the use of the Procedure Professionals Association (PPA) AP-907-005, *Procedure Writer's Manual* [7]. Some TA-V procedures could not be performed as written. The contractor's reliance on a standardized template by PPA for procedure writing also has some execution limitations (e.g., the template does not allow the procedure writer to insert guides, pictures, etc. in the body of the procedure).
 - ACRR-MP-005, *Fuel Handling and Storage*, Prerequisites Section 4 (Sections 4.1.1 and 4.1.2) [5] could not be completed in the sequence as written because steps in Section 5.0 needed to be completed first. The supervisor marked the 13 steps in Sections 4.1.1 and 4.1.2 as complete during the review team's observation of the procedure implementation prior to the specified actions being executed. The video record showed that a similar issue took place during the National Technology and Engineering Solutions of Sandia, LLC (NTESS) management self-assessment (MSA) where the operator captured the fuel element when there was no explicit step in Section 5 of Appendix D to capture the fuel element prior to moving it, thereby not following the procedure.
 - ACRR-OP-001, *Pre-Operation Checklist*, [8] Section 5.2.1, contains pre-operational steps to check operability of certain gauges and flowmeters. The components are labeled, but the procedure callouts do not match the equipment labels, as required by DOE Order 422.1 [1]. The procedure only describes the component to be inspected and does not include the alpha-numeric identifier, contrary to good work practices.
 - The review team evaluated AHCF-OP-026, *Campaign 20 – Qualification of ACRR Spare Fuel Elements* [9], and found that Sections 5.1–5.5 of the continuous use procedure (steps to be performed in sequence and as written) cannot be performed as written. Each of the five sections contains a step to go to a different appendix. Instead of completing the appendix called out and returning to Section 5 to read the next section/step, the operators read and perform Section 5.1 which sends them to Appendix A, then continued with Appendices B through E without returning to the procedure steps. The facility supervisor informed the review team that performance of the procedure as described was based on the pre-job briefing.
 - ACRR-OP-013, *Hoisting and Rigging*, Revision 1 [10], contains permissive phrasing (i.e., may) instead of more prescriptive phrasing (i.e., shall) and vague terms (i.e., if desired, as necessary, more cautiously, as prudent, if necessary). Section 1.2.12 refers to ACRR-MP-020, *Experiment Safety* [11]. This is a Reference Use procedure utilized by the ACRR staff in collaboration with

experimenters for the completion of the ACRR Experiment Plan Form, which ensures adequate review of the hazards of experiments performed in and around the ACRRF reactor core. An evaluation of the procedure indicated that lack of an adequate Experiment Plan may have been a contributing cause of the August 31, 2021, off-normal lifting event which involved an experiment test fixture contained in a lead-boron bucket. On October 18, 2021, ACRR issued Revision 2 to ACRR-OP-013 [12] to correct issues identified during the hoisting event analysis. This revision did not address the more prescriptive phrasing issues discussed above.

- **Procedure Classification:** *Implementation of Conduct of Operations in TA-V* [13] and *Document Lifecycle Management Procedure (DLMP)* [6] define continuous, reference, information, and multiple use procedures. “Continuous use” is required for complex work, and each step is read before performing each action. While “Reference Use” procedures allow for the conduct of work without in-hand use of the procedures, the execution of more complex work with specific sequential steps, sign-off steps, or conditional steps should be “Continuous Use” procedures to ensure safe work completion. ACRR-OP-013, *Hoisting and Rigging*, Revision 1 [10], is designated for “Reference Use” instead of the more appropriate “Continuous Use,” even though it contains sequential steps, sign-off steps, conditional steps, and required data record sheets. (The revision to ACRR-OP-013 cited above did not change its use category.) The review team notes that this procedure could be designated as “Multiple Use” per the TA-V DLMP. However, to do so, each section must be clearly defined as either continuous use or reference use.

In some sections of procedure ACRR-MP-016, *FREC II, Coupling and Decoupling* [14], work that is controlled by the facility is listed as continuous use, while equivalent work that is the responsibility of the experimenter is listed as reference use. The review team concluded that since both activities are complex work, both should be designated as continuous use.

Formality and Rigor of Operations—The review team noted several issues associated with the formality and rigor of operations, including placekeeping.

- During the on-site portion of the review, the review team found that TA-V management procedures do not provide clear and comprehensive direction on how the reader-worker protocol should be implemented. Managers and workers provided inconsistent answers when questioned on the communications requirements/expectations for this specific work. Several workers stated that communication needs were based on the level of experience of the team members performing the work and could be minimized or adjusted if the team had worked together before.
- The review team noted a decline in the rigor and formality displayed by the operators from the time of the MSA demonstration in December 2020 to July 2021 when the review team was on site. The primary difference observed in formality between the

MSA video and the on-site observation of fuel handling procedure was communication, specifically three-way communications. For example, procedure use protocols, such as reading of the procedure steps, varied depending on who was reading/managing the procedure. During the MSA, the reader was the person-in-charge and was more engaged in observing and controlling the fuel handling operation. Repeat-backs and feedback that steps were successfully completed were more consistently communicated during the MSA. At times the MSA person-in-charge asked operators if they understood a step when they did not immediately acknowledge the step. The review team did note weaknesses in rigor and formality in the MSA, including that although most of the steps were read verbatim during the MSA, some were paraphrased and rushed at times. In addition, the MSA reader communicated only about half of the notes and cautions in the procedure. Such lapses could result in operators failing to safely complete the procedures.

- The review team noted the critical lift plan developed for fuel element inspection jig work activity was developed and approved without proper controls to ensure that all equipment was inspected and the critical lift plan was properly reviewed and approved prior to the work activity. This lack of work controls could have resulted in equipment damage and possible personnel injury. Chronological inconsistencies with respect to review and final approval signatures for SF 2001-CLD (1-2021), *Critical Lift Data Sheet*, Revision 2 [15], (approved May 11, 2021) for the fuel element inspection jig revealed the improper work controls. Records indicate that the safety engineer completed the review nine days before it was prepared, and a pre-lift meeting was verified to be completed more than three months prior to the data sheet being completed. Section 5, Certifications/Inspections, could not be performed as written since it has requirements for verifying that the equipment is inspected prior to the lift plan being approved but includes pre-use and frequent inspections which are time sensitive. Despite this, the step was signed off as complete seven months before this revision was approved and nine months before performance of the work the review team observed. The signature dates are not in compliance with instructions for Section 10 which states, “Approved By: Ensure the department manager of the lift and responsible safety engineer sign and date these areas to indicate their approval of the lift procedure after all other information on the form is completed.” The review team discussed this issue with Sandia Field Office (SFO) and ACRRF management, who acknowledged the problem and stated managers would take steps to correct. The review team reviewed SF 2001-CLD (1-2021) *Critical Lift Data Sheet*, Revision 4 [16] (approved October 19, 2021) and noted that the issues identified above had been corrected.
- The review team reviewed SF 2001-POC (10-2012), *Pre-Use Inspection Form Overhead Cranes* [17], which was used to complete the inspection of the three-ton crane. This form has several inspection requirements calling for compliance with the manufacturer’s recommendations. These steps were signed off as completed satisfactorily. The pre-use inspection form is generic in nature and requires further guidance from the manufacturer to complete a satisfactory inspection. Yet when the review team requested the specific manufacturer’s inspection requirements, ACRR

staff responded that the manufacturer's requirements were not readily available. Subsequently, the ACRR staff located the manufacturer's crane operation manual and provided a written (email) response that did not adequately justify how the inspection process met the requirements. The ACRR staff has used and completed this form for years without having the manufacturer's recommendations readily available or incorporating the requirements into local/specific procedures for this specific crane. This shows a lack of attention to detail as well as a lack of a questioning attitude which together render the pre-use inspection potentially inadequate.

- The review team reviewed the *Implementation of Conduct of Operations in TA-V* (Revision 4), effective August 26, 2020 [18], which states, "Placekeeping is used when a continuous use or reference use procedure or work instruction is performed.... Placekeeping aids include initial blocks, check boxes, or documenting required information.... If no placekeeping aids are provided other methods may be used to placekeep such as check marks, circle-and-slash, or other means that clearly demonstrate what steps were completed." Placekeeping is a proven method of ensuring that procedures are performed as intended, without steps being inadvertently skipped or inappropriately repeated. Inadequate placekeeping can result in unsafe execution of procedures.
 - While observing the performance of Section 5.5. of ACRR-MP-005 [5], the review team noticed steps that did not include placekeeping (5.5.1-5.5.3). There were places where the review team observed circle/slashes at the beginning and end of steps, some circle/slashes only at beginning of steps, and some circle/slashes only at end of steps.
 - The review team also reviewed MSA videos of operations staff performing activities where operators' use of placekeeping was sporadic or inconsistently documented, including crane checkout (May 12, 2021); fuel handling (May 7, 2021); and removal of the fuel element inspection jig (May 7, 2021).
 - During the site visit and in the videos of operations, the review team observed that operators did not read notes and cautions or perform placekeeping for them using any of the methods mentioned in *Implementation of Conduct of Operations in TA-V* (Rev 4) [18]. During evolutions performed by the operations staff both on video and in person, the operations staff did not identify omissible/omitted steps prior to beginning the evolutions. Additionally, it was not clear to the review team which parts of the procedure were considered skill of the craft, since not all steps were placekept.

Radiological Contamination Control—Radiological work practices associated with retrieving items from the ACRR reactor pool are inconsistent with the safety expectations that should surround a potentially contaminated pool.

- DOE Order 422.1 [1], as cited in the *TA-V Conduct of Operations Matrix* [19], requires that "...operators remain aware of their radiological, toxic, or other

exposures and take action to minimize them.” [See DOE Order 422.1 [1], 6-29-2010, Attachment 2, Appendix A, 2.b (5) procedures for protecting operators from personnel hazards, e.g., chemical radiological, laser, noise, electromagnetic, toxic, or nano-scale materials. - item d.)] However, the review team observed on multiple occasions the operators handling wet equipment removed from the ACRR reactor pool without personal protective equipment or contamination surveys, even though removal of the fuel element inspection jig requires surveying the feet for contamination.

- During the response to the fourth off-normal lifting event, ACRRF staff did not issue personal dosimetry to the Sandia National Laboratories (SNL) hoisting and rigging subject matter expert (SME), instead choosing to rely on dose reconstruction despite a reasonable expectation that the SME might need to closely approach a direct radiation source.
- During the Fuel Element Inspection FRA, the radiological control technician took swipes to monitor for contamination only on the bottom parts of the legs of the fuel element inspection jig. During the demonstration, the operators routinely made contact with ACRR pool water by touching the wire rope as the inspection jig was moved while using no personal protective equipment (e.g., latex gloves). The radiological control technician stated that process knowledge and the applicable radiological technical work document stated “no potential contamination” from the pool. This represents reliance on expectations instead of requirements.
- A recent contamination event at ACRRF highlighted the need to consistently employ effective radiation protection practices. RPIR-2020-3 reported 10k dpm beta/gamma contamination on personal clothing detected by routine frisk at TA-V, Building 6588, Room 10 on April 30, 2020. A fact finding conducted immediately following the event determined the likely cause was handling of contaminated cabling. The review team noted deficiencies in dispositioning this occurrence, including that SNL did not perform a causal analysis or record any related event comments; SNL did implement a work practice improvement, but there was no mention of documenting this in a procedure or Technical Work Document/Radiological Technical Work Document for permanence, and SNL did not originate any lessons-learned.

Hoisting and Rigging—The review team noted a variety of safety issues associated with hoisting and rigging. As described below, SFO and NTESS have taken corrective actions to improve the hoisting and rigging program at ACRRF, but several opportunities for improvement remain.

- The SNL *Causal Analysis Report of ACRR* [20], dated October 6, 2021, identified seven root causes and six contributing factors related to the four hoisting and rigging incidents at ACRR over the last 2-1/2 years. The commentary during interviews and analysis of comments for about half of the total root cause/causal factors evaluations indicated that job performance of operations personnel was adversely affected by their training, work planning and assignments, interactions with experimenters and

- managers, and procedures. Following the factual accuracy out-brief with the review team on December 9, 2021, NTESS developed a corrective action plan in January 2022 to address the root causes and contributing factors identified in the causal analysis report. The corrective action plan [21] does not appear to include continued facilitated discussions with operations personnel, experimenters, and facility managers to track progress in resolving impediments to their job performance.
- On October 18, 2021, ACRRF management issued Revision 2 to ACRR-OP-013, *Hoisting and Rigging* [12], to correct issues identified during the event analysis. The review team evaluated the revised procedure and reached the following conclusions:
 - The revision addressed past failures to properly plan and control critical lifts by adding a step stating that “IF the lift is a critical lift THEN PREPARE OR USE an approved critical lift plan using the ACRR Critical Lift Plan Writer's Guide.” The review team noted that this new revision no longer listed multiple types of critical lifts at ACRRF, which was a deficiency in the prior revision. NTESS is now committed to always preparing a lift plan for critical lifts at ACRRF. However, the procedure does not incorporate and attach relevant lift documents such as the critical lift plan lift writer’s guide, critical lift data sheet, lift determination form, and lift director checklist.
 - Recent hoisting events at ACRRF made it evident that use of a load sensing device (dynamometer) was not effectively employed in all lifts near the reactor or storage pools. Revision 2 of ACRR-OP-013 [12] corrected this problem by requiring use of a load sensing device unless specifically exempted. The October 2021 revision of the critical lift data sheet from the fuel inspection jig [16] accordingly mandates using a dynamometer. This instrument will help alert operators to a variety of unintended conditions that can arise during a lift, including problems encountered during recent lifting events.
 - The review team identified a lack of clarity on whether the revised procedure is standalone or, as stated in the procedure, it supplements DOE Standard 1090-2020, *Hoisting and Rigging* [22], by stating SNL-specific implementation requirements as well as any deviations.
 - Critical lift plans and the *ACRR Critical Lift Plan Writer's Guide* [23] are not approved operating procedures developed in accordance with the *Document Lifecycle Management Procedure* [6] and the *Procedure Writer’s Manual* [7] as required by the *TA-V Conduct of Operations Matrix* [19]. Moreover, relevant lift documents such as the critical lift plan lift writer’s guide, critical lift data sheet, lift determination form, and lift director checklist lack document identifiers, approvals, owners, and defined applications. The review team also identified the concern that ACRR-OP-013, *Hoisting and Rigging* [12], uses permissive phrasing (i.e., should, may, are expected) instead of more prescriptive phrasing (i.e., shall, are required) for performing some action steps. Addressing these deficiencies will help ensure that lifts are appropriately planned and executed safely.

- The review team evaluated configuration management, pre-use inspection, and current working status of the three-ton crane in ACRR. The initial installation and configuration of the crane did not include the current wireless remote controller interface. Records provided did not identify if an engineering evaluation or manufacturer’s review supported the equipment modification, adequate retesting, and potential changes to the pre-use inspection requirements. The review team noted a timing out function of the wireless remote controller on multiple occasions. The corrective action plan for the hoisting and rigging systemic causal analysis [21] identified this condition as a “distraction” but identified no corrective actions. Conversely, the causal analysis report [20] concluded that the potential impact was that “Crane operator loses ability to control crane as desired (crane stops randomly) due to handheld remote losing connection with crane.” The review team considers this to be a potential safety issue due to the potential inability to respond to a holding brake failure while not under direct control, which is a requirement of the manufacturer’s operations manual. The contractor has not adequately addressed this issue, and it was not discussed as part of pre-job briefings that the review team observed.
- The review team observed the crane operator manipulating the load while operating the crane, which is contrary to Sandia Corporate expectation as discussed with Sandia Corporate critical lift subject matter experts in a teleconference on August 5, 2021. The safety expectation is that crane operator must have only one job—crane operations with no distractions. When crane operators manipulate the load, they are distracted from their responsibility for operations and can become part of a potential problem if a safety situation develops.
- The recent history of hoisting and rigging events suggests that NTESS and SFO oversight of the TA-V hoisting and rigging program has been ineffective. While there have been numerous interactions between NTESS and SFO regarding hoisting and rigging events following each successive event, SFO’s oversight has not driven marked improvement in hoisting and rigging operations at ACRRF and further, SNL Corporate had not periodically assessed the TA-V hoisting and rigging program. The SFO TA-V facility representative noted three corporate assessments in the past three years that included TA-V; however, these assessments were not specifically focused on hoisting and rigging at TA-V. An independent assessment by the SNL contractor assurance organization, quality assurance organization, or the organization responsible for hoisting and rigging program performance would provide additional confidence that the TA-V hoisting and rigging program is being safely and compliantly implemented. Similarly, either DOE or its hoisting and rigging advisory committee could also consider performing an assessment based on the number of recent significant hoisting and rigging events.

Organization and Administration—An analysis of conduct of operations documents associated with organization and administration resulted in the observations below.

- **TA-V Conduct of Operations Matrix:** DOE Order 422.1 [1] requires the Conduct of Operations Matrix to demonstrate implementation of a conduct of operations program by providing a matrix consisting of entries for each specific requirement and each included detailed attribute set forth in Attachment 2 to the Order. The entries report applicability (“applicable,” “partially applicable” or “not applicable”) for each facility (ACRRF, Sandia Pulsed Reactor/Critical Experiment Facility, AHCF) and each requirement and detailed attribute. The matrix cites implementing documents for “applicable” entries and justifications for “partially applicable” and “not applicable” entries. SNL initially provided the *TA-V Conduct of Operations Matrix* (Rev. 2 effective October 20, 2015) [24] for review. The review team subsequently determined the document was not current when compared with the content of *Implementation of Conduct of Operations* in TA-V, Rev. 4, dated August 26, 2020 [18], and that SFO approved Rev. 3 of the matrix [19] in July 2021. The review team based its review on Rev. 3.
 - NTESS did not review and revise the prior revision of the *TA-V Conduct of Operations Matrix* (effective October 20, 2015) [24] in a timely manner as required by Attachment 2 to DOE Order 422.1 [1]. Section 1.c. of Attachment 2 states in part that the operator (contractor) must review, update, and obtain approval of documentation demonstrating conformance at inception, when changes in conditions require changes in the documentation, and at least every three years or as directed by DOE.
 - Rev. 3 of the matrix [19] is a significant upgrade from the prior revision, with many more detailed attributes indicated as applicable with implementing documentation cited, which replaced attributes indicated as partially applicable or not applicable with justifications.
 - Requirement 2.i.(2) of the matrix requires the operator to establish and implement operations practices that address the detailed attributes of 11 elements for the installation and removal of caution tags for equipment protection or operational control. The matrix designates this requirement as partially applicable for the three facilities. The matrix provides the justification that SNL Corporate has provided danger tags and administrative tags and that an additional TA-V-specific caution tag system may confuse personnel familiar with SNL Corporate administrative tags. The matrix adds the justification that the functions of administrative control tags caution tags are similar, and that administrative control tags are managed per section 5.8 of the TA-V Lockout and Tagout Procedure [25]. The review team evaluated these justifications and found that SNL Corporate administrative controls and tags are used for a variety of Corporate-wide purposes and lack the rigor necessary for a caution tag program used by a Hazard Category 2 nuclear facility specifically for equipment protection or operational control. Caution tag programs have been in place and recognized as an important element contributing to safety of operations and used successfully for many years at DOE defense nuclear facilities. This requirement should be applicable instead of partially applicable.

- **“Pause Work” and “Stop Work”:** A formal process has not been established to “pause work” (defined in TAV-AP-008, page 20) [2] and “stop work” with steps to initiate, identify, report, address and resolve associated concerns and issues and resume work. Stop work is mentioned in several documents but without reference to a process for implementing the action. Following the August 31, 2021, lifting event, a pause on ACRR crane operation was put in effect, with the SNL 1300 Center Director’s approval required for each exception to the pause, but no policy or procedure was in place to formalize and implement this decision. Clearly defined pause work and stop work processes are essential elements of an effective response to emergent safety concerns.

- **Document Lifecycle Management Procedure:** The review team reviewed *Document Lifecycle Management Procedure* [6] and noted that section 6.2.1 requires operating procedure validation (tabletop or walkthrough to ensure operating procedure can be performed as written) for only Level I procedures. Validation is optional for Level II and III procedures although Level II procedures include those that control activities with direct impact on radiological safety and facility reliability. Procedure level is not included in the information on the cover sheet of procedures. However, the *TA-V Conduct of Operations Matrix* [19] detailed attribute 2.(7)(e) requires validation of all operating procedures. The Board’s staff previously noted this concern in its September 2016 review of conduct of operations and maintenance. Proper validation of procedures that may impact safety plays an important role in ensuring that procedures can be executed safely.

- **Procedure for Implementation of Conduct of Operations:** *Implementation of Conduct of Operations in TA-V*, Revision 4, effective August 26, 2020 [18] is cited throughout the Sandia National Laboratories’ (SNL) *Technical Area V (TA-V) Conduct of Operations Matrix*, Revision 3 [19] as the document that implements detailed attributes of applicable requirements in the matrix. The review team reviewed the procedure for consistency with other documents, implementation of applicable requirements from Department of Energy (DOE) Order 422.1 [1], correctness, clarity, usability, formality, and rigor. The review team’s observations on selected subsections of the procedure are summarized below:
 - **Purpose.** The first two sentences of the Purpose subsection state, “This Conduct of Operations administrative procedure establishes the expectations for the formality of operations to be employed during operations at TA-V nuclear facilities. These expectations are commensurate with requirements of DOE Order 422.1, *Conduct of Operations*, as cited in the *TA-V Conduct of Operations Matrix*” [19]. Use of the terms “expectations” and “commensurate” are inconsistent with the mandatory status of the Order’s requirements and suggest that verbatim compliance is optional. Permissive words such as “expected,” “may,” and “should” are used throughout the procedure instead of prescriptive words such as “required” and “shall” that express more clearly the formality and rigor that are necessary for implementing requirements of DOE Order 422.1 [1].

- **Section 4.1, Definitions.** This section defines “Critical step” as a “...procedure step, series of steps, or action that, if performed improperly, will cause irreversible harm to plant equipment or people or will significantly impact plant operation.” Direction regarding critical steps could be improved by adding information or a reference on how critical steps are identified in procedures or identified for review during pre-job briefings.
- **Section 5.1.1, Organization Roles.** The last paragraph of this section states that operations personnel and all knowledgeable TA-V personnel are vested with “stop work” authority should an unsafe condition be encountered. Direction regarding stop work authority could be improved by noting that personnel not only have “stop work” authority but are responsible for using this authority should an unsafe condition be encountered, and by providing a description or reference for the stop work process.
- **Section 5.2.5, Procedures for Protecting Operators from Personnel Hazards.** This subsection includes statements that operations personnel “...are expected to follow good personnel practices ...” and “... are expected to observe the following requirements...” This subsection implements requirements cited in section 2.b.(5) of DOE Order 422.1 [1], but the statements are communicated as expectations instead of requirements.
- **Section 5.2.6, Prompt Response to Instrument Indications.** This subsection includes statements that “Operators are expected to believe instrument readings and treat them as accurate unless proven otherwise ...” and “In situations of operator doubt, operators are expected to place facility, personnel, and environmental safety above facility customer needs.” The statements implement DOE Order 422.1 [1] requirements, but they are communicated as expectations instead of requirements.
- **Section 5.3.3, Surveillance of Control Panels.** The first sentence of this subsection states that “Operators are expected to be alert and attentive to control panel indications and alarms.” This is a requirement and should be communicated as such, not as an expectation.
- **Section 5.4.2, Administrative Control of Communications Equipment, and Section 5.4.3, Methods for Control Areas to Contact Operators and Supervisors.** These subsections describe the use of public address equipment, portable radios, cell phones/pagers, and intercom stations, but TA-V has not formally established and implemented a structured plan for operations personnel to use such equipment for communications.
- **Section 5.16.1, Expectations for the Use of Procedures to Perform Operations.** The review team identified several concerns in this subsection:

- It uses the words “expectations,” “expected,” and “should” numerous times for actions required by DOE Order 422.1 [1], instead of the more prescriptive language needed to ensure the requirements are treated as such.
 - It includes a statement that “a) Critical steps for a procedure or work instruction are identified during the task preview or pre-job briefing” and includes critical steps in a list of items to keep in mind when performing procedures. However, no reference or information is provided on how critical steps are identified.
 - The list of items to keep in mind when performing procedures also includes instructions on performing immediate actions of emergency procedures that are not consistent with the instructions provided in section 2.3, Precautions and Limitations, of ACRR-OP-008, *Operations Emergency Event/Abnormal Operating/Alarm Response Procedures*, Revision 14, dated October 18, 2021 [26].
 - It includes direction on how to proceed if an action or condition called for by a procedure step is found to already exist. This direction allows the operator to proceed without contacting a supervisor if two steps requiring evaluation yield satisfactory results. The direction is nonconservative because the supervisor should always be contacted first if a condition called for by a procedure step is found to already exist. The supervisor may have knowledge of plant conditions or planned work not known to the operator that need to be considered before proceeding.
- **Operations Emergency Event/Abnormal Operating/Alarm Response Procedures.** Lastly, the review team identified several concerns in Section 2.0, Precautions and Limitations, of ACRR-OP-008 [26]. Concerns in this section are summarized below:
 - Subsection 4) states that immediate actions in section 4.1, Emergency Event Response Procedures, identified by red flowchart symbols, should be memorized. This direction fails to recognize that most, if not all, emergency response procedures have too many immediate actions to be memorized with realistic retention. The direction lacks a statement to the effect that when conditions permit, the applicable emergency response procedure should be used to ensure that all immediate actions have been completed. This is consistent with expectations for the use of procedures to perform operations stated in *Implementation of Conduct of Operations in TA-V* [13] section 5.16.1.
 - Subsection 9) provides three ways to shut down the reactor when directed but does not include conditions for selecting a way other than scrambling the reactor, which would appear to be the most desirable choice.
 - Subsection 11) states that intermittent alarms often occur for various reasons during normal operations and may not require completing the actions in section 4.3, Alarm Response Procedures. This subsection states further that the reactor operator(s) and reactor supervisor must use their experience and knowledge to

determine when directed responses are not required. This direction is less rigorous than provided in *Implementation of Conduct of Operations in TA-V* [13] section 5.2.6, which includes statements that operators are trained to believe instrument readings unless proven otherwise and that when malfunctioning or inaccurate instruments are discovered, they are appropriately identified to prevent subsequent confusion, and appropriate personnel are notified to effect repairs.

References

- [1] Department of Energy, *Conduct of Operations*, DOE Order 422.1 Chg. 3, Washington, DC, October 4, 2019.
- [2] Sandia National Laboratories, *Activity Level Work Planning & Control Procedure*, Technical Area V, TAV-AP-008, Revision 12, January 21, 2021.
- [3] Department of Energy, *Activity-Level Work Planning and Control Implementation*, DOE Handbook 1211-2014, Washington, DC, June 2, 2014.
- [4] Sandia National Laboratories, *Pre-Job Briefing Form*, SF 2001-PJC.
- [5] Sandia National Laboratories, Technical Area V, *Fuel Handling and Storage*, ACRR-MP-005, TA-V, Revision 9, May 2021.
- [6] Sandia National Laboratories, Technical Area V, *Document Lifecycle Management Procedure*, Revision 10, August 31, 2020.
- [7] Procedure Professionals Association, *Procedure Writer's Manual*, Revision 3, PPA AP-907-005, December 2019.
- [8] Sandia National Laboratories, Technical Area V, *Pre-Operation Checklist*, ACRR-OP-001, Revision 24, October 20, 2021.
- [9] Sandia National Laboratories, Technical Area V, Auxiliary Hot Cell Facility, *Campaign 20 – Qualification of ACRR Spare Fuel Elements*, Revision 0, AHCF-OP-026, Annotated copy of procedure completed on December 2, 2020.
- [10] Sandia National Laboratories, Technical Area V, *Hoisting and Rigging*, Revision 1, ACRR-OP-013, June 2020.
- [11] Sandia National Laboratories, Technical Area V, *Experiment Safety*, Revision 12, ACRR-MP-020, September 15, 2020.
- [12] Sandia National Laboratories, Technical Area V, *Hoisting and Rigging*, Revision 2, ACRR-OP-013, October 2021.
- [13] Sandia National Laboratories, Technical Area V, *Implementation of Conduct of Operations in TA-V*, Revision 5, effective March 30, 2021.
- [14] Sandia National Laboratories, Technical Area V, *FREC II Coupling and Decoupling*, Revision 8, ACRR-MP-016, November 1, 2021.
- [15] Sandia National Laboratories, *Critical Lift Data Sheet*, Revision 2, ACRR Fuel Inspection Jig, SF 2001-CLD (1-2021), May 2021.

- [16] Sandia National Laboratories, *Critical Lift Data Sheet*, Revision 4, ACRR Fuel Inspection Jig, SF 2001-CLD (1-2021), October 2021.
- [17] Sandia National Laboratories, *Pre-Use Inspection Form Overhead Cranes*, SF 2001-POC (10-2012), October 2012.
- [18] Sandia National Laboratories, Technical Area V, *Implementation of Conduct of Operations in TA-V*, Revision 4, effective August 26, 2020.
- [19] Sandia National Laboratories, Technical Area V, *TA-V Conduct of Operations Matrix*, Revision 3, effective July 2, 2021.
- [20] Sandia National Laboratories, *Causal Analysis Report of Annular Core Research Reactor (ACRR)*, October 6, 2021.
- [21] Sandia National Laboratories, *Corrective Action Plan for the Hoisting and Rigging Systemic Causal Analysis*, Revision 0, January 7, 2022.
- [22] Department of Energy, *Hoisting and Rigging*, DOE-STD-1090-2020, July 1, 2020.
- [23] Sandia National Laboratories, Technical Area V, *ACRR Critical Lift Plan Writer's Guide*, Revision 0, no effective date provided.
- [24] Sandia National Laboratories, Technical Area V, *TA-V Conduct of Operations Matrix*, Revision 2, effective October 20, 2015.
- [25] Sandia National Laboratories, Technical Area V, *TA-V Lockout and Tagout*, Revision 1, January 3, 2018.
- [26] Sandia National Laboratories, Technical Area V, *Operations Emergency Event/Abnormal Operating/Alarm Response Procedures*, ACRR-OP-008, Revision 14, effective October 18, 2021.