Thomas A. Summers, Acting Chairman
Patricia L. Lee

DEFENSE NUCLEAR FACILITIES SAFETY BOARD

Washington, DC 20004-2901

March 17, 2025

The Honorable Christopher Wright
Secretary of Energy
U.S. Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585-1000

Dear Secretary Wright:

Last year, the Defense Nuclear Facilities Safety Board's (Board) staff reviewed three nuclear criticality safety programs within the Department of Energy (DOE) complex and identified areas for improvement to enhance safety. Key findings included contractor workforce retention issues, which have impacted consistent implementation of criticality safety controls, and a need for stronger requirements and guidance to support a less experienced contractor workforce. DOE would also benefit from improving feedback mechanisms to identify and resolve root causes more effectively.

The Board's staff identified best practices at certain DOE sites and encourages DOE to promote these practices across the complex. The Board concludes that DOE's nuclear criticality safety programs require targeted improvements. The enclosed report provides a detailed summary of the Board's staff findings and is intended to support DOE's improvement efforts. The Board acknowledges and appreciates DOE's recent nuclear criticality safety workshops as valuable steps toward addressing complex-wide challenges and anticipates further discussion on these issues. The Board looks forward to discussing these and associated emerging topics during DOE's upcoming annual nuclear criticality safety briefing.

Sincerely,

Thomas A. Summers
Acting Chairman

Enclosure

c: Mr. Joe Olencz, Director, Office of the Departmental Representative to the Board

DEFENSE NUCLEAR FACILITIES SAFETY BOARD

Staff Report

November 18, 2024

Nuclear Criticality Safety Review

Summary. A staff review team from the Defense Nuclear Facilities Safety Board (DNFSB) evaluated the overall health of nuclear criticality safety (NCS) programs at the Department of Energy's (DOE) defense nuclear facilities with a focus on:

- Maintenance of sufficient technical capability to perform work safely,
- Quality of NCS evaluations in identifying all credible abnormal conditions and selecting adequate controls,
- Methods and processes used to ensure all NCS controls and assumptions are protected,
- Adequacy of implementation of NCS controls,
- Resolution of infractions and deviations, and
- Effectiveness of contractor and DOE oversight.

The intent of this review was to evaluate complex-wide safety concerns and best practices. DNFSB Technical Report 29 (DNFSB/TECH-29), *Criticality Safety at Department of Energy Defense Nuclear Facilities*, was written to align with the core functions of integrated safety management (ISM) and states "introducing and maintaining an adequate program in criticality safety offers an excellent example of application of ISM." [1] This review followed a similar framework.

The staff team selected three sites to evaluate: Y-12 National Security Complex (Y-12), Savannah River Site (SRS), and Los Alamos National Laboratory (LANL). Both SRS and LANL include multiple site contractors—the SRS review covered programs implemented by Savannah River Nuclear Solutions, LLC (SRNS), the site management and operating contractor, and Savannah River Mission Completion (SRMC), the liquid waste contractor, while the LANL review included only Triad National Security, LLC. These three sites have the largest and most active nuclear criticality safety programs in the DOE complex. The staff team reviewed documents, developed lines of inquiry, conducted interviews, and performed field observations.

The existence of recent corrective actions indicates that management at all sites believe their NCS programs could improve. The DOE field offices are actively engaged with their

contractors in trying to ensure these corrective actions are effectively resolving issues. The staff team did not identify any imminent NCS hazards, but it did identify three improvement areas that will help DOE and its contractors resolve current NCS challenges and improve the effectiveness of NCS programs:

- **Retention challenges** for key contractor NCS roles have adversely impacted implementation of NCS controls.

- **Requirements and guidance** need improvement to enhance the reliability of NCS controls.

- **Feedback mechanisms** need improvement to ensure root causes of issues are identified and corrected in a timely manner.

The staff team views the workforce of contractor criticality safety staff and operators as the foundation of criticality safety programs. As this workforce foundation is challenged, the DOE complex that it supports is adapting to its own changes. Those changes include new missions, increased production workloads, significant deactivation and decommissioning activities, and large-scale new nuclear facility construction projects. The combination of the workforce challenges and a changing DOE complex warrants DOE's focused attention on improving the three areas listed above.

Background. Title 10, Code of Federal Regulations (CFR), Part 830, Subpart B, Section 204(b)(6) requires DOE contractors to define NCS programs in the safety basis for all "nonreactor nuclear facilities with fissionable material in a form and amount sufficient to pose a potential for criticality" [2]. NCS programs must "identify applicable nuclear criticality safety standards, describe how the program meets applicable nuclear criticality safety standards," and ensure that "operations with fissionable material remain subcritical under all normal and credible abnormal conditions" [2]. Appendix A to Subpart B of 10 CFR 830 states:

> *The types and specific characteristics of the safety management programs necessary for a DOE nuclear facility will be dependent on the complexity and hazards associated with the nuclear facility and the work being performed…. In general, DOE Orders set forth DOE's expectations concerning specific topics. For example, DOE Order 420.1, or successor document provides DOE's expectations with respect to fire protection and criticality safety.*

Chapter III of Attachment 2 of DOE Order 420.1C, *Facility Safety*, contains additional NCS requirements, and the order invokes the American National Standards Institute (ANSI)/American Nuclear Society (ANS)-8, *Nuclear Criticality Safety Standards*. The order requires a criticality safety program document that "must describe how the contractor will satisfy the requirements of the ANSI/ANS-8 series of nuclear criticality safety standards" and "must be submitted to and approved by the DOE Head of Field Element." [3]

DOE field offices oversee the effectiveness of contractor NCS programs in meeting all NCS requirements. The order also invokes DOE-STD-3007-2017, *Preparing Criticality Safety*

Evaluations at Department of Energy Nonreactor Nuclear Facilities [4], which contains additional NCS requirements. Together, the regulations, order, DOE standard, and ANSI/ANS-8 standards provide a sufficient regulatory framework for NCS programs. In addition, 10 CFR 830 also recognizes the importance of effective ISM processes to preclude the need for additional requirements. It states:

> *The processes embedded in a safety management system should lead to a contractor establishing adequate safety bases and safety management programs that will meet the safety basis requirements of this Subpart. Consequently, the DOE expects if a contractor has adequately implemented integrated safety management, few additional requirements will stem from this Subpart and, in such cases, the existing safety basis prepared in accordance with integrated safety management provisions, including existing DOE safety requirements in contracts, should meet the requirements of this Subpart.*

Implementing robust ISM processes is foundational to ensuring an effective NCS program. ANSI/ANS-8.19-2014, *Administrative Practices for Nuclear Criticality Safety* [5], is an invoked consensus standard containing requirements that are essentially ISM for criticality safety. It states:

> *An effective nuclear criticality safety program fosters an acceptable balance of risk and benefit. This includes cooperation among management, supervision, nuclear criticality safety staff, and workers. Criticality safety relies on evaluations, implementation and maintenance of controls, and each employee's conformance with operating procedures. Although the extent and complexity of safety-related activities can vary greatly with the size and type of operation with fissile material, certain safety elements are common. This standard represents a codification of such elements related to nuclear criticality safety.*

DOE Handbook 1211-2014, *Activity-Level Work Planning and Control Implementation* [6], identifies best practices for implementing ISM at the activity-level, which is primarily where NCS hazards are controlled. ISM has seven guiding principles and five core functions as shown in Figure 1.

Figure 1. *Guiding Principles and Core Functions of ISM*

One of the guiding principles of ISM is clear roles and responsibilities. Table 1 represents some of the key roles identified in ANSI/ANS-8.19-2014 and DOE Handbook 1211-2014 that implement the five ISM core functions. Each document describes responsibilities for these roles. The last column is who typically performs these roles and how they will be referred to in this report. Some sites may have slightly different formal titles for these roles. An additional role, the criticality safety officer (CSO), while not explicitly defined in ANSI/ANS-8.19-2014, has played a key role in DOE NCS programs for years. The standard allows supervisors to obtain assistance from others in fulfilling certain responsibilities, which often align with CSO responsibilities. The CSO could also have responsibilities that align with criticality safety staff responsibilities outlined in the standard. The staff team interviewed several personnel in all these roles, including CSOs, as part of this review.

Table 1. *Key Roles Implementing ISM for NCS Programs*

ANSI/ANS-8.19	DOE Handbook 1211	Staff Report*
Management	Senior management and responsible manager (line management)	Management
Supervisors	Work supervisor	Fissile material handler (FMH) supervisors
Personnel under supervision	Worker	FMHs
Criticality safety staff	Subject matter expert	Criticality safety engineers

*CSOs were also evaluated and interviewed

ISM processes must effectively develop, maintain, and implement hazard controls for all types of hazards, not just criticality safety hazards. For most facility workers, the NCS hazard is not as intuitive as other industrial hazards (e.g., heat stress and electrical hazards), which presents an additional challenge. Because NCS hazard controls may conflict with other hazard controls (e.g., fire protection) or rely on elements in other safety management programs (e.g., conduct of operations), NCS programs must interface with other safety management programs as part of ISM. This requires criticality safety engineers to not only be proficient in the field of nuclear criticality safety, but also to be effective at interfacing with other safety management programs and the workers in the facility.

Ultimately, management is responsible for safety at the facility, but subject matter experts (e.g., criticality safety engineers) provide technical guidance to ensure hazards in their area of expertise are effectively identified and controlled by operations (e.g., FMH supervisors and FMHs). In addition, management is required to provide sufficient, qualified staffing to effectively perform all ISM and NCS program functions. However, to the extent practicable, management should maintain NCS functions "administratively independent of operations" per ANSI/ANS-8.19-2014 [5]. To complement the ISM guiding principles and functions, DOE Policy 450.4A, *Integrated Safety Management Policy*, states "the Department expects all organizations to embrace a strong safety culture where safe performance of work and **involvement of workers in all aspects of work performance are core values** that are deeply, strongly, and consistently held by managers and workers." [7] [emphasis added] While work terms may differ in different standards, ISM applies to all work activities (e.g., operational processes, maintenance, construction, deactivation, and decommissioning).

For a specific work activity, three ISM core functions (define scope of work, analyze hazards, implement hazard controls) are documented in a nuclear criticality safety evaluation (NCSE). DOE-STD-3007-2017 provides requirements and guidance on acceptable methods for developing and documenting NCSEs that are compliant with the ANSI/ANS-8 series of standards. In developing a NCSE, DOE-STD-3007-2017 states, "The criticality safety engineer relies on other organizations such as operations, system engineering, maintenance, and nuclear materials control and accountability to assist" in implementing various ISM core functions [4].

The description section of a NCSE defines the **scope of work** and establishes the boundaries of the activity being analyzed. The NCSE then documents the **hazard analysis** done to meet the requirements of ANSI/ANS-8.1-2014, *Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors*. Specifically, "Before a new operation with fissionable material is begun, or before an existing operation is changed, it shall be determined that the entire process will be subcritical under both normal and credible abnormal conditions." [8] A hazard evaluation team will determine what NCS hazard scenarios are "credible" for a given work activity as defined by ANSI/ANS-8.1-2014, which states:

> *The word "credible" is not defined in the standard but relies on the judgment of the key professionals involved (nuclear criticality safety staff, operations supervisors, etc.) to determine the credible abnormal conditions for a particular fissionable material operation.*

The hazard evaluation team also determines the magnitude of credible scenarios and whether some hazard scenarios are bounded by other credible hazard scenarios.

The NCSE then documents the **NCS controls** necessary to prevent a criticality accident for all normal and credible abnormal conditions. DOE-STD-3009-2014, *Preparation of*

Nonreactor Nuclear Facility Documented Safety Analysis [9], contains requirements for performing the safety classification of NCS controls. It states:

> *NCS controls derived in accordance with the DOE-approved NCS Program are required to be implemented in accordance with 10 C.F.R. Part 830, Subpart A, Quality Assurance Requirements, commensurate with the importance of the safety functions performed. Explicit criticality controls required as a result of hazard evaluation criteria established in Section 3.1.3.2 shall be documented in the DSA* [documented safety analysis] *and classified in accordance with requirements of Sections 3.3.1 and 3.3.2.*

Section 3.1.3.2 of DOE-STD-3009-2014 outlines the NCS controls to consider for classification as safety class or safety significant. These are typically active engineered NCS controls and criticality accident alarm systems that primarily protect the facility worker, since most criticality events do not exceed public or co-located worker consequence thresholds. Passive and administrative controls are not explicitly included. DOE-STD-3007-2017 states that Section 3.1.3.2 of DOE-STD-3009-2014 does not include administrative NCS controls because "administrative controls are generally considered the least reliable type of controls, and therefore, the least preferable method to ensure subcriticality." [4] Section 6.3 of DOE-STD-3007 states:

> *There is no prescribed or preferred method to document the basis for elevation of SSCs* [structures, systems, and components] *to the DSA…. The method used should be identified in the criticality safety program description document to obtain DOE approval or concurrence. Supporting information derived from the NCSE that is useful in performing a functional classification determination in the DSA includes:*
>
> - *A summary of the fissionable operation*
> - *A summary of the NCS control strategy for that operation*
> - *The safety function of the SSC*
> - *The functional requirement of the SSC*
> - *The performance criteria of the SSC.*

Regardless of the classification, DOE-STD-3009-2014 requires all NCS controls to be implemented and maintained through quality assurance programs using a graded approach "commensurate with the importance of the safety functions performed." [9] Safety class and safety significant controls are commonly assigned a higher grading level in quality assurance programs to ensure higher quality and reliability for those controls. If NCS controls are not classified as safety class or safety significant, then the controls could be assigned a different grading level within the quality assurance program. All NCS controls identified in the NCSE undergo an implementation process to ensure they are in place prior to performing the work activity. After that, NCS controls are maintained through change control and other quality assurance requirements (e.g., maintenance, training).

The fourth ISM core function, **performing work within controls**, is often when NCS infractions are identified. However, a root cause of the infraction could be due to a breakdown in the first three ISM core functions and not simply a conduct of operations or work control issue. Thus, establishing robust ISM **feedback and improvement** mechanisms, as the fifth ISM core function, is paramount for ensuring safe nuclear operations. Standard ANSI/ANS-8.19-2014 has requirements for monitoring and assessing NCS program implementation. In addition, Attachment 1 of DOE Order 226.1B, *Implementation of Department of Energy Oversight Policy*, requires DOE contractors to establish a contractor assurance system that "includes assignment of management responsibilities and accountabilities and provides evidence to assure both the Department of Energy's (DOE) and the contractor's management that work is being performed safely, securely, and in compliance with all requirements; risks are being identified and managed; and that the systems of control are effective and efficient." [10]

Discussion. The staff team reviewed documents, developed lines of inquiry, conducted interviews, and performed field observations at Y-12, SRS, and LANL. These sites have well established NCS programs with requirements that align with the ANSI/ANS-8 series of NCS standards. The DOE field offices are knowledgeable of NCS program elements when approving contractor NCS program documents to ensure NCS programs meet all NCS requirements.

The staff team reviewed a sample of NCSEs that covered a range of material forms and processes (e.g., solution, metal, remotely operated, manual activities, storage, support systems), which are listed in Appendix A. The NCSEs sufficiently document the description of the process and the analysis done to ensure the process remains subcritical during all normal and credible abnormal conditions. Some NCSEs could benefit from improved documentation of assumptions as required by DOE-STD-3007-2017, but this was a minor concern.

Appendix A of ANSI/ANS-8.1 notes, "The few criticality accidents that have occurred in industrial operations have resulted from failure to anticipate conditions that might arise; not one has resulted from a faulty calculation of [the effective multiplication factor] k_{eff}." [7] Therefore, identifying a comprehensive list of credible abnormal conditions is essential to the overall effectiveness of NCS programs. When a hazard scenario is identified as credible, the reviewed NCSEs adequately document the analysis showing that a subcritical state is maintained. However, if analysts overlook a credible scenario, no analysis is performed.

Given that many of the staff team's questions centered around whether a particular hazard scenario was considered credible, it could enhance transparency to provide more information on scenarios *considered* by the hazard evaluation team to aid with knowledge transfer to new staff. In addition, the staff team found a few examples in which NCSE documentation could be improved by noting when a hazard scenario is bounded by another hazard scenario already analyzed in the NCSE.

The staff team reviewed examples of NCSEs that were based on the 2007 version of DOE-STD-3007 and example that were based on the 2017 version, noting an improvement in the quality of the NCSEs that had been developed based on the 2017 version. Given the general improvement in analytical evaluations and documentation of NCSEs, the staff team concluded that site personnel should now shift their focus to monitoring the effectiveness of NCS programs, rather than just compliance. This would be in line with the observations from DNFSB/TECH-29 related to monitoring the effectiveness of existing NCS controls in operating areas. As DNFSB/TECH-29 [1] stated:

> *Criticality* [safety] *engineers must continue to increase their presence on the process floor. Time spent on the floor makes criticality safety engineers more familiar with the relevant fissile material processes; facilitates operator input with regard to criticality control strategies, which ultimately translates into safer operations; and makes it more likely that a criticality safety engineer will identify potential problems at an early stage.*

The staff did not identify any imminent hazards with respect to NCS controls. However, three complex-wide improvement areas that will help DOE and its contractors resolve current NCS challenges and improve the effectiveness of NCS programs are:

- **Retention challenges** for key contractor NCS roles have adversely impacted implementation of NCS controls.

- **Requirements and guidance** need improvement to enhance the reliability of NCS controls.

- **Feedback mechanisms** need improvement to ensure root causes of issues are identified and corrected in a timely manner.

Each of these improvement areas are discussed further in the next sections of this report. The staff team also identified best practices from this review for DOE to consider when addressing these improvement areas, which are summarized in Appendix B.

Contractor Personnel Retention Challenges Have Adversely Impacted Implementation of NCS Controls—Staffing retention challenges for both junior and senior contractor personnel have impacted the ISM principles of "clear roles and responsibilities," "balanced responsibilities," and "competence commensurate with responsibilities." DOE Guide 450.4-1C, *Integrated Safety Management System Guide* [11], lists basic attributes for each ISM guiding principle and core function. For "balanced priorities," DOE Guide 450.4-1C identifies "staffing levels and capabilities are consistent with the expectation of maintaining safe and reliable operations" [11] as a basic attribute. Retention challenges have also contributed to breakdowns of ISM core functions, most notably, the implementation of NCS controls.

Based on discussions with site managers, retention challenges may exist for other safety disciplines. The staff team recognizes that retention challenges exist broadly within the nuclear industry, but this review focused on retention challenges related to NCS programs. The staff team gathered information on retention and attrition challenges at every site related to the key NCS roles listed in Table 1. Staffing data is always fluid, but the general trend for many of these key roles is an increasing rate of loss of senior staff to retirement and a decreasing rate of retention for recently hired staff around the five-year mark. While senior staff attrition has been a challenge for years, failing to retain a new cadre of experienced personnel to take their place could have prolonged impacts. In April 2024, the staff team requested staffing data for key NCS roles that provide specific examples of the broader retention challenges to varying degrees.

- **Fissile material handlers and supervisors.** Contractor FMH supervisors oversee FMH staff as they perform work within NCS controls. When performing work, FMH staff follow postings and procedures that have incorporated controls from NCSEs. The staff team reviewed the training for these positions and found the training to be compliant with ANSI/ANS-8.20-1991, *Nuclear Criticality Safety Training* [12], requirements. However, the staffing data shows most staff do not have more than five years of experience in these positions. Note that the data in Figures 2 through 4 is based on the qualification date for these specific roles and does not include previous experience at another facility or accumulated nuclear industry work experience.

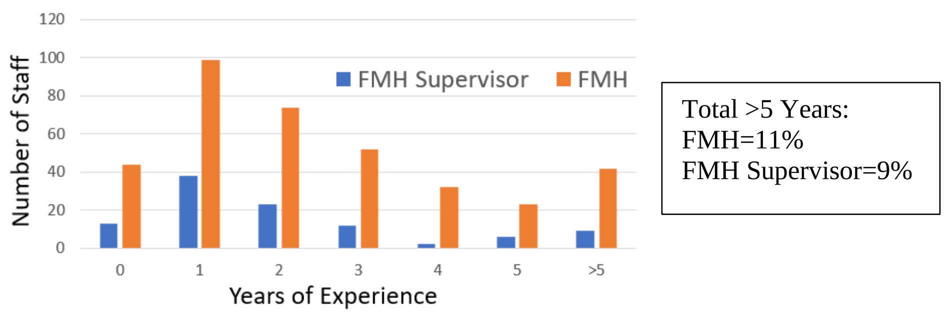

Figure 2. *Technical Area 55 (TA-55) Contractor FMH Staffing at LANL*

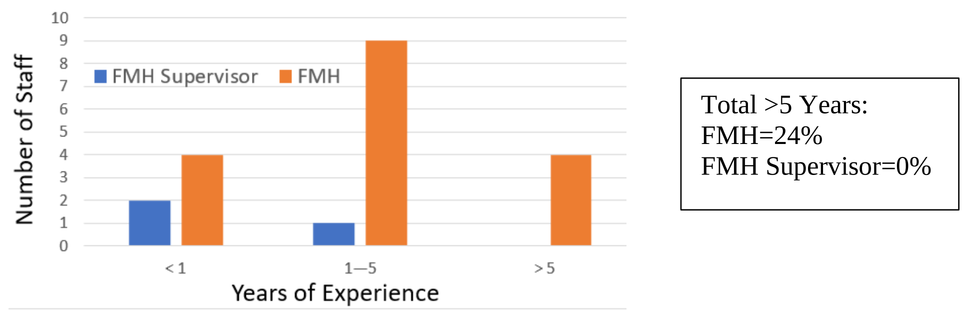

Figure 3. *L-Area Contractor FMH Staffing at SRS*

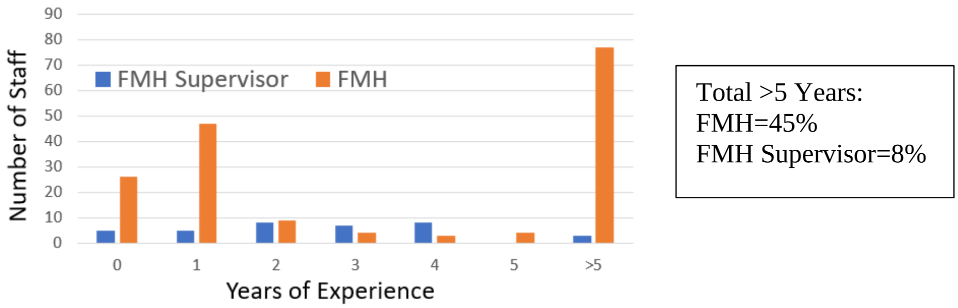

Figure 4. *Enriched Uranium Operations Contractor FMH Staffing at Y-12*

The years of experience shown for FMH supervisors correspond to the estimated time that they have been in a FMH supervisor role in their current position. Total years of nuclear operations experience could not be determined from the training data. Based on interviews, the experience of FMH supervisors varied from extensive prior nuclear operations experience to minimal prior nuclear operations experience since a FMH supervisor does not have to be a former FMH worker per ANSI/ANS-8 requirements[1]. Despite the data limitations, Figures 2 through 4 show that retaining personnel in the FMH supervisor role has been a challenge.

Figure 4 for Y-12 shows 45 percent of FMH staff having more than five years of experience in their current positions. However, there is not a corresponding pipeline resulting in a stable FMH workforce to learn from and eventually replace experienced personnel when they retire. The trend is even worse for FMH supervisors in this figure. During interviews, many senior staff noted that the primary reason they stayed in these roles was due to a pension that no longer exists for new hires. These issues will be a challenge for all sites including sites that currently have experienced workers.

The reasons stated for not wanting to become a FMH supervisor were the loss of union status and concerns that the added responsibility was not worth the tradeoffs. From interviews, site management shared that many college graduates may routinely shift out of their initial career field. In some cases, it may be beneficial for NCS personnel to change positions. For example, moving to other organizations at the site can bring useful NCS background to those positions. However, this can challenge efforts to maintain and grow operational experience.

- **Criticality safety officers.** Both LANL and Y-12 contractor CSOs are part of the operations staff and not part of the NCS divisions. These CSOs are typically assigned and qualified to a process area but LANL also has a group of programmatic CSOs that have cross-cutting responsibilities. SRNS and SRMC CSOs are NCS staff who qualify as CSOs for a particular facility and are often already qualified as criticality safety engineers. Thus, the CSOs for SRS facilities also have criticality safety engineer responsibilities. The roles and responsibilities for CSOs are described in site

[1] ANSI/ANS-8.20 requires training for FMH and FMH supervisors, but it does not specifically require former FMH experience to be an FMH supervisor. [12]

implementing procedures and vary from site to site. In general, CSOs provide a key interfacing role between the NCS division and operations that assists in effectively implementing NCS controls. Note that the data in Figures 5 and 6 is based on the qualification date for these specific roles and does not include previous experience at another facility.

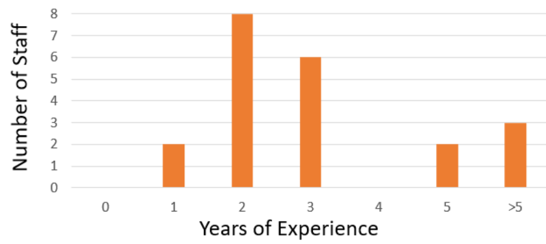

Figure 5. *LANL TA-55 Contractor CSO Staffing*

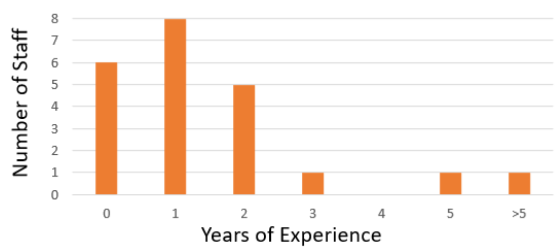

Figure 6. *Y-12 Contractor CSO Staffing*

- **Criticality safety engineers.** Contractor criticality safety engineer staffing is reported annually to DNFSB as part of DOE's annual reporting requirement on NCS programs. As the subject matter experts on protecting workers from NCS hazards, criticality safety engineers provide technical guidance to operations, maintenance, and construction personnel. The staff team reviewed the training for criticality safety engineers and found the training to be compliant with ANSI/ANS-8.26-2007, *Criticality Safety Engineer Training and Qualification Program* [13].

    - In April 2024, Y-12's breakdown of qualified criticality safety engineers experience was 14 with less than 5 years of experience, 8 with between 5 and 20 years of experience, and 11 with more than 20 years of experience. In addition, Y-12 has approximately 20 criticality safety engineers who are in the qualification process. Between the first quarter of fiscal year 2022 and the second quarter of fiscal year 2024, Y-12 had a cumulative loss of 26 criticality safety engineers but was successful in hiring replacements (onboarded 41) to maintain a relatively stable number of qualified criticality safety engineers (~30 excluding subcontractors). The NCS staffing metric in April 2024 stated, "retention remains a persistent issue across Y-12 at this time." The National Nuclear Security Administration Production Office (NPO) fiscal year 2024 risk rating of the Y-12 NCS program noted that Y-12 "has had difficulty retaining qualified NCS staff….

NPO has observed degrading performance in multiple areas of the program that could be attributed to lack of experience and over-extended resources."

- In 2023, the DOE Criticality Safety Support Group (CSSG) reported that LANL was struggling to retain criticality safety engineers after the number of qualified criticality safety engineers dropped from 19 to 11, excluding subcontractors, by the end of 2022. LANL management was in the process of making several changes to the NCS division to address this concern during the staff team's review interactions in 2023. The April 2024 revision to their NCS staffing plan stated, "the positive trajectory for staffing has been negatively influenced by a rise in attrition starting in 2020."

- At SRS, the majority of SRMC criticality safety engineers are subcontractors. SRMC has maintained a relatively stable number of seven qualified criticality safety engineers, two of whom also perform CSO duties. Similarly, SRNS has maintained a stable number of criticality safety engineers and CSOs even as the more experienced workforce retires.

Retention challenges in all these roles have led to a decline in the average experience level of these positions. The majority of contractor personnel in these roles has less than five years of experience. Retention challenges have often led to increasing the scope of responsibility for the remaining staff in these positions. First line supervisors, CSOs, and criticality safety engineers are assigned multiple process areas due to staffing shortages. Even when the scope of responsibility does not increase, a less experienced workforce is often less proficient at performing assigned responsibilities. Both factors can dilute the overall effectiveness of NCS personnel in performing assigned responsibilities such as:

- Interfacing with other groups (e.g., maintenance, operations, non-destructive assay) to build trust and a shared vision on integrating safety,

- Identifying all credible hazard scenarios,

- Observing field operations to ensure effectiveness of NCS controls, and

- Training and mentoring newer employees.

Attrition of senior staff has resulted in a lack of mentors in these positions, which can limit how many new hires a site can effectively mentor at one time. Also, failing to retain the next cadre of experienced personnel may limit the number of available mentors for the foreseeable future. This is particularly important in the DOE complex because extenuating circumstances can sometimes lead to extended time between evolutions for a given operational process, during which attrition can result in the weakening of institutional knowledge. For example, some aqueous operations at LANL have been paused for more than a decade; maintaining a workforce with experience operating the aqueous processes over that period is challenging.

Managers at all sites have been performing exit interviews to identify potential ways to address retention issues, but site personnel indicated during interviews that some solutions may need to be addressed at a higher level, including:

- Reinstating pensions,
- Offering rotational or professional development opportunities, and
- Implementing broader use of retention incentives.

Retention challenges are a concern that will likely continue to impact sites complex-wide. While contractors have been relatively successful at hiring new staff, they have struggled to retain them as they become experienced workers and mentors. If this trend continues, it will create a cycle of wholesale turnover of key NCS roles every five years. Identifying problems through exit interviews is one potential avenue that DOE and contractors could use to monitor why staff are leaving and evaluate possible site-specific and complex-wide policies to combat the turnover.

Retention is measured against the staffing needs for each key NCS role. Sites have different methods for performing staffing analyses to ensure they can effectively meet all assigned responsibilities. Determining how many FMH staff, FMH supervisors, CSOs, and criticality safety engineers a facility needs is challenging. This analysis includes mission support needs and NCS program needs, both of which fluctuate. The staffing analysis also must be predictive because of the time it takes to qualify new staff. A less experienced workforce may require more staff than was previously needed with an experienced workforce.

The staff team reviewed each site's staffing analysis for key contractor NCS roles and found them to be both quantitative and qualitative. Among all the groups interviewed during this review, L-Area at SRS had the best morale among criticality safety engineers and CSOs even though the work activities were somewhat repetitive and located in a remote area on site. The staff team attributed the high morale to the NCS manager who successfully implemented their staffing analysis, which maintains criticality safety engineer and CSO staffing levels to meet peak NCS needs while identifying other professional development opportunities during slower times when NCS demands were lower. Using a staffing analysis framework that includes flexible staffing goals was considered to be a best practice with regard to retention because the criticality safety engineers and CSOs never felt overworked and could continue their professional growth.

LANL management invested in a new training center that provides hands-on training for glovebox operations as well as vault and drum storage. Y-12 management also developed new hands-on conduct of operations training for FMH staff. The staff team is encouraged to see site management improving the fidelity of their training programs. However, while the initial training and qualification programs for key NCS roles are sufficient, improvements in continuing training programs will be needed due to the loss of experienced mentors in the workplace.

Feedback from qualified FMH staff, FMH supervisors, CSOs, and criticality safety engineers is very important in determining the aspects of their training that need improvement. During interviews, some newly qualified staff stated they often rely on mentors to fill in any knowledge gaps from their initial training. If the number of experienced mentors continues to decline, site manager may have to enhance their current training programs to address the current reliance on mentors.

Mentoring is often considered a collateral duty, and current mentors reported feeling underappreciated and are fatigued due to continued staffing losses. Frequently, as soon as mentors invest their time in one new worker, that worker leaves and they have to start over with the next one. Y-12 management hired an experienced criticality safety engineer to mentor and train new criticality safety engineers as their primary responsibility. Employing dedicated mentors to address the current mentor shortages and fatigue is considered a best practice. Some site managers have successfully used retirees as a valuable mentoring and training resource. DOE could evaluate eliminating barriers and constraints that limit the amount of time a retiree can work or that financially penalize a retiree for working.

Continued communication with the workforce is essential to retain experience in key NCS roles. In addition to exit interviews, interviewing experienced workers as to why they stay in these roles could provide additional insight into addressing retention challenges. Site management should identify mentors currently in these roles and seek their feedback for other possible improvements.

For key NCS roles, site management needs to ensure long-term career paths remain an enticing option for new staff. This not only means competitive pay and advancement without leaving the role, but also offering a competitive work-life balance and other benefits. Some of the interviewees expressed a desire for increased authority regarding work controls as they gain experience within key NCS roles.

Contractors should communicate to DOE retention solutions that require higher level authority. Retention challenges may persist until complex-wide solutions are identified. A less experienced workforce can still operate safely. However, effective ISM processes incorporate the “skill of the worker” as described in DOE-HDBK-1211-2014 and tailor the rigor needed in performing ISM core functions to the experience of the workforce. Thus, the final two improvement areas identified in the staff review, and discussed next, can help mitigate the impacts of prolonged retention challenges and ensure safe operations with a less experienced workforce.

Requirements and Guidance Need Improvement to Enhance the Reliability of NCS Controls—As workforce experience declines due to high turnover and poor retention, additional requirements or guidance could be needed to effectively implement NCS programs. As stated earlier in the report, the staff team believes that the framework of NCS requirements contained in the federal regulations, DOE orders and technical standards, and the ANSI/ANS-8 series of consensus standards is sufficient to ensure safe operations.

At some sites, the contractor(s) directly map each ANSI/ANS-8 standard requirement to specific implementing procedures within their NCS program document, which is a best practice. However, DOE may need to push its contractors to expand and adapt the requirements and guidance contained in these site implementing procedures to accommodate a less experienced workforce. This would strengthen the ISM principles of "identification of safety standards and requirements" and ensuring "hazard controls are tailored to work being performed" to ensure sufficient reliability and effectiveness of NCS controls.

A basic attribute in DOE Guide 450.4-1C for these ISM guiding principles is "Hazard controls are designed with an understanding of the potential for human error. Error-likely situations are identified, eliminated, or mitigated. The existence of known error-likely situations is communicated to workers prior to commencing work, along with planned mechanisms to assure worker safety." [11]

To help explain why site documents could use improvement, consider that many ANSI/ANS-8 series of standards contain requirements that allow NCS programs flexibility in how to effectively implement them. For example:

- Section 8.6 of ANSI/ANS-8.19-2014 states, "Operations shall be reviewed at least annually to verify that procedures are being followed and that process conditions have not been altered so as to affect the nuclear criticality safety evaluation." [5] The staff team observed that the rigor in performing this activity can vary and personnel at different sites have different expectations regarding what this review should cover. For example, Y-12 management requires the performance of operations to be observed as part of this review, which is considered a best practice.

- Section B.2 of ANSI/ANS-8.1-2014 states, "The word 'credible' is not defined in the standard but relies on the judgment of the key professionals involved (nuclear criticality safety staff, operations supervisors, etc.) to determine the credible abnormal conditions for a particular fissionable material operation." [8] Site implementing procedures define the process for determining "credible" upset scenarios and document their basis. This determination relies on judgment of key professionals. New staff should participate in these processes but may not have the experience to make informed decisions on credible abnormal conditions. As a result, the current site training on performing a hazard analysis may need enhancements with a less experienced workforce.

- Section 8.5.1 of ANSI/ANS 8.19-2014 states, "Procedures should be organized for convenient use by operators and be conveniently available. They should be free of extraneous material." [5] The standard allows for flexibility in interpreting what is meant by "conveniently available" and "free of extraneous materials" when developing procedures.

Site implementing procedures could require varying rigor and conservatism in meeting these and other ANSI/ANS-8 requirements, and site contractors could more easily tailor local procedures. For example, if site management desires more "field time" for criticality safety engineers and CSOs, site procedures can mandate more walkdowns or specific activities that require field time. NCS controls require quality assurance "commensurate with the importance of the safety functions performed" [9], which provides contractors additional flexibility.

As stated earlier, DOE improved requirements in DOE-STD-3009-2014 by specifying that certain NCS controls, such as active engineered controls, be considered for classification as safety class or safety significant. However, since most NCS controls are not active engineered controls, site management usually considers elevating NCS controls to the safety basis based on additional site-specific criteria. Documenting this determination varied among the sites. The staff team did not have any concerns with the proper elevation of NCS controls, but site management could improve their documentation for these decisions. Comparing site specific criteria for elevating NCS controls among sites could also improve consistency across the complex.

Figure 7 shows the breakdown of NCS controls by the type of control (e.g., active engineered, passive engineered, or administrative) from the NCSE review samples in Appendix A.

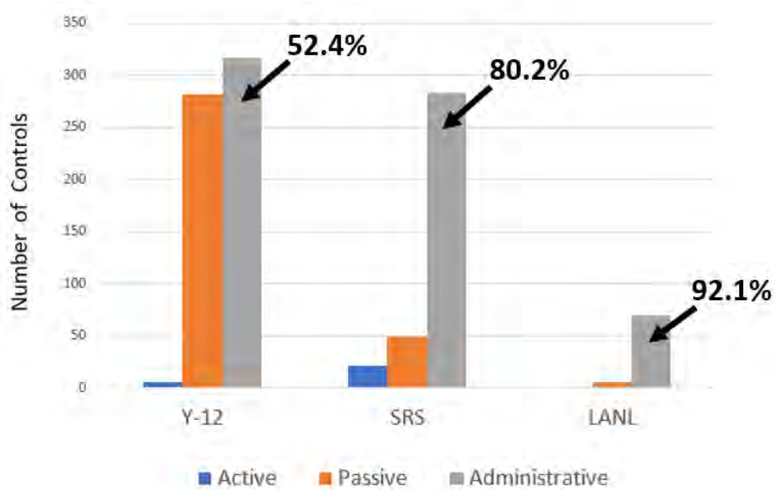

Figure 7. *Breakdown of Sampled NCS Controls by Type*

Current DOE requirements do not explicitly dictate how to maintain the reliability of NCS controls that are not elevated to the safety basis, which is important because most controls for processes the staff team reviewed were not elevated to the safety basis. Thus, non-elevated NCS controls could be maintained at various grading levels within quality assurance implementing procedures. Figure 7 shows that most of the sampled NCS controls were either passive engineered controls or administrative controls. For those NCS controls, site personnel used varying rigor to ensure reliability, as allowed by requirements. This also means that site management can enhance that rigor within their quality assurance programs, which may be needed with a less experienced workforce.

Improving the maintenance of passive NCS controls was also discussed in DNFSB/TECH-29, which concluded "Criticality-related design features need to be covered by a formalized maintenance and configuration management program… for ensuring that these controls do not degrade such that they can no longer be relied upon to perform their intended function." [1]

The formality and rigor in applying quality assurance functions (e.g., procurement, testing, maintenance) to passive NCS controls will depend on the quality assurance grading level that site personnel assign to the NCS control. During the review, the staff team discussed whether NCS controls that are not elevated to the safety basis should have an enhanced level of quality assurance over standard industrial hazard controls. For example, higher quality assurance standards for procurement, inspection, and testing could be applied to a container relied upon to prevent water intrusion as part of the NCSE controls.

Further, if the NCS program leverages existing controls that are credited for other reasons or owned by other organizations, the assurance that the other organization maintains the aspects of the control that are important to NCS should be established. The Y-12 contractor performs a degradation evaluation, which is similar to that performed on safety-related controls, on all passive NCS controls regardless of their classification to identify whether surveillances or inspections are needed to monitor for degradation. This improves reliability for passive NCS controls and is considered a best practice. This also illustrates the flexibility that site management has to enhance the reliability and quality assurance of NCS controls within their own implementing procedures.

The staff team observed a heavy reliance on administrative NCS controls, which was also identified in DNFSB/TECH-29. Administrative controls are less reliable than engineered controls, and the staff team observed several different approaches for enhancing the reliability of administrative NCS controls. At a minimum, most sites require marking administrative NCS control steps with an identifier (e.g., an asterisk) within the procedure. Additional approaches for improving the reliability of implementing NCS administrative controls at various sites included:

- Using second person verification or independent verification when implementing a NCS control to improve the reliability of implementing the control,
- Using multiple sample points to ensure a representative sample and analyzing replicates to improve the reliability of sampling data,
- Using multiple non-destructive assay measurements to improve the reliability of measurement data,
- Mandating pre-job briefing requirements to discuss specific NCS controls to improve the reliability of implementing those controls,
- Using enhanced quality assurance testing and calibration for installed process equipment relied upon to implement administrative NCS controls (a best practice at SRS),

- Using consistent NCS control limits, to the extent practical, to enhance the reliability of operators in remembering those limits,

- Using human factors and reliability analyses when developing administrative NCS controls,

- Using "continuous use" procedures in lieu of "reference use" procedures when implementing administrative NCS controls to reduce errors, and

- Placing NCS controls directly at the step in the procedure that implements the control rather than in a "precaution" section of the procedure.

For administrative NCS controls that are elevated to a specific administrative control, DOE-STD-1186-2016, *Specific Administrative Controls* [14], contains safety requirements and guidance on acceptable methods for developing and implementing specific administrative controls. For NCS controls that are not elevated to specific administrative controls, the standard can still be a great resource to consider when looking to improve the reliability of administrative controls.

Concepts like redundancy and independence can be used to help improve the quality and reliability of NCS controls. Section 3 of DOE-STD-1186-2016 lists several measures that can be taken to improve the reliability of administrative controls. Furthermore, DOE Handbook 1028-2009, *Human Performance Improvement Handbook* [15], provides human error reduction methods to improve reliability.

In addition, the hands-on criticality safety course provided by the DOE Nuclear Criticality Safety Program contains a lesson on human factors and reliability principles for criticality safety evaluations. The NCS community recognizes the importance of human reliability in effectively implementing NCS controls, and DOE provides standards and handbooks on how best to apply it. Site management should require citing this information in NCS procedures for developing and implementing administrative NCS controls. Enhancing the reliability of administrative NCS controls would greatly improve NCS program implementation due to the current reliance on administrative controls shown in Figure 7.

All sites have a formal process to initially implement the controls identified in NCSEs. After a control is implemented, there are limited requirements for maintaining a crosswalk between NCS controls in the NCSE and implementing procedures, surveillances, and in-service inspections. Ideally, change control and configuration management processes ensure controls remain in place after initial verification.

The Y-12 contractor maintains a crosswalk document for each NCSE that lists how each NCS control is implemented, which assists their staff in periodically verifying these controls remain intact. The SRS contractor maintains a linking document database that provides a similar linkage of NCS controls to their surveillances and operating procedures. These methods are considered best practices in ensuring the reliability of NCS controls. Site management should look to implement this capability as it enhances the ability to verify that NCS controls are maintained.

There are limited requirements to periodically re-evaluate NCSEs for the adequacy of credible hazard scenarios, the accuracy of the analyses, and the periodic verification of implementation of NCS controls. The staff team identified several examples in which the current criticality safety engineers or CSOs could not explain the basis in the NCSE because the staff who wrote the evaluation were no longer on site. Ultimately, the contractors were able to prove that there were no safety issues but agreed to provide additional clarity in future NCSE revisions. As staff turnover continues, management at all the sites agreed that continuous improvement in documentation is vital to future understanding and implementation of NCS controls.

For FMH staff and supervisors, the constant turnover has resulted in new operators who were not part of the NCS hazard evaluation and control selection teams. A core value of ISM is having the workers involved in all core functions to ensure they understand all potential hazards and the basis for controls. When involved in the ISM process, workers can provide feedback on what controls are effective including specific language for postings and procedures to help ensure compliance. While there are always new operators inheriting previously developed controls, site management should look for ways to assist operators. For example, site management may need to enhance initial training and qualification to help operators understand why specific NCS controls are in place.

Another area of training that needs to be improved is awareness of NCS controls for non-FMH-qualified staff who can impact NCS controls, such as craft workers, maintenance workers, and deactivation and decommissioning workers when they are working in areas that have NCS controls. Management at all sites had corrective actions in progress to address this concern during the time of this review. The integration part of ISM can be challenging, but the key is always ensuring that workers and NCS staff are involved in every ISM core function to ensure work is performed safely. Workers, regardless of experience, need to be involved in all ISM core functions to better understand the hazards and "buy-in" to the NCS controls.

Y-12 management began the process of reviewing all NCSEs every five years, and SRS management reviews NCSEs every three years. NCS programs generally credit the required annual operational reviews to periodically review NCSEs and associated controls. The staff team evaluated site implementing procedures for these reviews and observed some field elements of these reviews. Annual operational reviews observed by the staff team had variable rigor as some reviews lasted fifteen minutes while others lasted over an hour.

Site procedures governing these reviews include sufficient scope. The staff team agrees that these reviews, if done regularly and thoroughly, can significantly improve the reliability of NCS controls. Based on the variability identified by the staff team and the limited experience for some NCS personnel, this is an area in which site NCS programs can enhance requirements or guidance within their site procedures to ensure these reviews are effective.

As contractor retention challenges persist, these annual reviews are an excellent opportunity for criticality safety engineers and CSOs to engage with FMH staff and supervisors on ISM core functions. Reviewing credible hazards and the basis for controls with FMH staff in the operating areas will improve implementation of controls and promote feedback that could improve NCS controls.

These reviews should be an opportunity to ask FMH staff and supervisors how criticality safety engineers and CSOs could help improve NCS control implementation; however, the staff team found that these reviews function more like an oral board for the operators. Approaching interactions with FMH staff and supervisors as a collaboration may make these annual reviews more effective.

Additionally, DOE could use the annual operations review to adjust NCS controls, if necessary, since the operations review inherently results in a gathering of knowledgeable personnel. Based on interviews, the staff team concluded that criticality safety engineers following up with FMH staff on how their ideas for potential changes or improvements are dispositioned could strengthen collaboration between operators and criticality safety staff.

The staff team observed that annual operational reviews may only cover a subset of the overall scope that a criticality safety evaluation encompasses. Site contractor personnel typically prioritize the scope of the operations review based on activity risk and availability to observe scheduled operations. The staff team identified examples of latent issues that persisted for multiple years related to activities that were not selected to be observed during successive operational reviews. Since it is not always practical to cover the full scope of activities during an annual operational review, tracking which specific activities are reviewed from year-to-year would provide visibility on which activities may not have been reviewed for several years. This visibility could help identify activities that warrant additional attention when planning future operational reviews or through another operational awareness activity.

As of part of the annual operational review process, the staff team did not identify any safety concerns with the technical guidance provided by the criticality safety engineers for normal and credible abnormal conditions. However, criticality safety engineers must continue to ensure that all credible hazard scenarios are identified and that NCS controls are effectively understood by an evolving workforce with new missions.

Feedback Mechanisms Need Improvement to Ensure Root Causes of Issues are Identified and Corrected in a Timely Manner—ISM includes a core function that requires robust feedback and improvement mechanisms from the workers up through management. Effective feedback mechanisms can help verify controls are effective, identify process drift from analyzed operations, and significantly improve safety culture. Contractor and federal oversight activities help support feedback and improvement mechanisms. Basic attributes in DOE Guide 450.4-1C for this ISM core function include, “Opportunities for improving work execution and planning are identified and implemented” and “Fundamental causes are determined” [11].

One important tool available to site management for facilitating feedback and improvement is the reporting and analysis of nuclear criticality safety infractions. Management at all three sites has created different grading levels for NCS infractions with unique definitions. DOE Order 232.2A, *Occurrence Reporting and Processing of Operations Information* [16], outlines four criteria for NCS control violations that must be reported to DOE.

SRS management has adopted the four criteria and developed a guidance document to supplement the order. The guidance document helps define terms in the order such as "documented control" and "adequate controls." The guidance document also provides a fifth category, which documents and tracks non-reportable NCS issues. LANL and Y-12 management also have defined NCS infraction grading levels that include categories for lower-level events that are not reportable.

Documenting low-level, non-reportable issues is considered a best practice, as those issues could be potential precursors to future, more significant events. However, the staff team observed at all sites that management does not regularly perform a trending analysis on infraction data to identify and address lower-level trends that may apply site-wide. Site management could require an annual trending analysis as part of their NCS program requirements and factor the additional resources needed to perform the trending analysis into their staffing needs analysis.

At Y-12, the NCS document manager issues monthly reports on the status of deficiencies and minor non-compliances to corrective action review board members who, along with the NCS Advisory Council, help monitor for trends. All sites have a process to identify and assign corrective actions for NCS infractions. However, the management of NCS corrective actions is generally specific to each infraction and segregated from other corrective actions. Higher significance NCS events at Y-12 and LANL can also be placed into the site-wide issues management system. This has contributed to challenges managing and communicating about NCS issues when multiple issues occur that have common elements. SRS management utilizes its site-wide issues management system for all NCS infractions, even for documenting low-level NCS issues.

NCS infraction categories do not capture when sites proactively self-identify NCS issues and pause work. Y-12 management developed a category for potential NCS issues and used it to document and resolve several potential issues that were identified by proactively reviewing NCSEs. Potential NCS issues are typically identified by an individual having a questioning attitude regarding the bounding nature of the analysis or issues with design analysis calculations that support a fissile process. The staff review team considers the potential NCS issues process a best practice as it promotes proactiveness and a questioning attitude.

During interviews, the staff team identified that fact findings and critiques conducted after NCS infractions need improvement. When a potential NCS infraction is identified, the culture surrounding these gatherings should be that of a learning opportunity for everyone involved. Without seeking out ways to provide such exposure to less experienced staff, fact finding activities will degrade, and may reach a point at which they fail to identify and effectively discuss problems and solutions. This issue could lead to repetitive problems, or infractions going unnoticed.

Investigating how site ISM processes may have failed the FMH staff rather than assuming the issue was a lapse in conduct of operations by a FMH operator promotes a healthy safety culture. If an event is ultimately determined to be a conduct of operations deficiency, site personnel need to perform more thorough causal analyses that identify the specific human reliability breakdowns.

As stated earlier, DOE-HDBK-1028-2009 contains several techniques to diagnose the anatomy of an NCS infraction beyond classifying it as a conduct of operations issue. Getting to the root of what caused the conduct of operations issue will help ensure effective resolution. In one case, after repeated infractions, the staff team witnessed the use of a "learning team" to directly incorporate worker feedback on a revision to a material transport procedure at LANL. Involving the workers as part of the solution in improving NCS controls is a best practice and consistent with ISM core values.

The staff team observed continued use of archived DOE-STD-1158-2010, *Self-Assessment Standard for DOE Contractor Criticality Safety Programs* [17], for performing self-assessments. Use of the *Contractor Assurance Best Practices Guide for Self-assessment and Continuous Improvement of Nuclear Criticality Safety Programs* [18] (authored by the CSSG), in performing self-assessments is a best practice as it improves the effectiveness of self-assessments.

All sites have developed unique NCS metrics that they continue to modify based on operational needs. Current metrics do not routinely predict future issues, and some metrics fail to define action thresholds that indicate corrective actions must be performed. NCS workshops and communities of practice could help improve metrics, especially leading metrics, to improve their overall value in monitoring the health of NCS programs. This is another area in which NCS programs have flexibility in defining their own metrics and using them as they deem appropriate. Because of this, site management should continually evaluate the effectiveness of their metrics. For example, if metrics did not predict an issue that occurred, contractors should consider whether an additional or modified metric is needed to better address the issue.

All sites have established NCS committees to help oversee implementation of the NCS program. However, the SRS committees no longer meet regularly. The staff team reviewed committee meeting minutes for LANL and Y-12 and determined that the committees are effective at identifying issues; however, the mechanisms in place to resolve these issues are not always effective.

For example, the LANL Nuclear Criticality Safety Committee's (NCSC) annual report to the laboratory director for fiscal year 2022 identified several issues that remained unresolved when the CSSG visited in 2023. In this case, LANL management was not effective at addressing the committee's concerns.

At Y-12, the NCSC maintains cognizance of the Y-12 NCS program and regularly identifies, tracks, and corrects issues. As a positive example of committee results, the external members of the Y-12 NCSC recently provided the impetus for Y-12 personnel to address a long-standing, open issue related to moving non-compliant material out of a production area.

However, the Y-12 NCSC corrective action process can be disconnected from other issue tracking systems. The NCSC meeting minutes have stated that the NCSC has limited bandwidth to review all NCS corrective actions and closures in other databases.

Site management can improve the use of external assessments to help improve NCS implementation. LANL management requested a CSSG assist visit in January 2023 to provide objective feedback on the NCS program. When CSSG feedback was provided, the field office directed the contractor to address the feedback. Welcoming external feedback is considered a best practice.

Similarly, sharing and incorporating NCS lessons learned between DOE sites is an important feedback and improvement mechanism. The NCS community has developed its own lessons learned database ("learning from experience") and maintains access to the database on the DOE Nuclear Criticality Safety Program website. The goal of the database is to highlight experiences at sites that might be applicable to others. The database allows the NCS community to share experiences anonymously and maintain a low bar for inclusion. Any NCS experience that others can learn from can be shared. Having an NCS community database can be a positive feedback mechanism provided the NCS community continues to implement the requirements of the DOE corporate operating experience program to develop operating experience products when warranted.

Conclusions. NCS programs at LANL, SRS, and Y-12 are well established, and DOE requirements effectively ensure safe operations. However, improvements are needed to enhance the effectiveness of site NCS programs. These improvements should focus on mitigating the impact of contractor retention challenges, implementing effective requirements and guidance to ensure reliable control implementation, and maintaining robust feedback mechanisms.

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Appendix A

NCSEs Reviewed by Staff Team

Y-12
Chip Drying and Briquetting
Denitrator
Intermediate Evaporators
Non-Special Nuclear Material Transfer Station
Special Process Packaging and Sampling
Stack 48
Stack 110
Tray Dissolvers
Ultrasonic Chip Cleaning
Wiped Film Evaporator

LANL
Shipping and Receiving Operations in Room 711, Wing 7 of the CMR Facility
Onsite Transfers of Significant Quantities of Fissile Material
Waste Container Staging, Handling, and Movement
Waste Solution Solidification and X-Ray Fluorescence Processes
Material Recovery and Recycle Operations
Aqueous Chloride Americium Separation and Purification
Wing 5 of CMR
Wing 7 of CMR
Oxide Roasting Operations
Deactivation and Decommissioning Activities to Remove GB-360
Draining Wet Vacuum Trap Tanks and Associated Material Disposal
Generic activities that take place in gloveboxes that are not seismically qualified
Standard Criticality Safety Requirements #1 -520g Operations in PF-4

SRS
Processing at DWPF
DWPF Glass
Storage of KAPL TTR Fuel in 6M/2R Containers in the Slug Vault
242-16H Evaporator System Operation and Cleaning
Double Contingency Analysis for the L Disassembly Basin
Concentration, Storage, and Transfer Facilities and Operations
Safety of Spent Fuel Dissolution
H-Canyon Double Contingency Analysis
Transfer Facilities Operations

Appendix B

Best Practices Identified during the Staff Review

Best Practices
Staffing to peak workload levels and providing developmental opportunities for non-peak times.
Employing dedicated mentors (including retirees who work part-time).
Mapping American National Standards Institute (ANSI)/American Nuclear Society (ANS) -8 standard requirements to specific implementing procedures.
Observing actual operations as part of the ANSI/ANS-8.19-2014 operational reviews.
Performing a degradation evaluation for passive nuclear criticality safety (NCS) controls.
Enhanced quality assurance testing and calibration for equipment relied upon to implement administrative NCS controls.
Mapping NCS controls to the implemented document for each evaluated process.
Documenting low-level, non-reportable NCS issues.
Using an evaluation process similar to a potential inadequacy of the safety analysis (PISA) to evaluate and resolve potential NCS issues with NCS evaluations.
Ensuring that the fissile material handlers (hands on workers) are part of the solution in improving NCS controls.
Use of the Criticality Safety Support Group (CSSG) authored *Contractor Assurance Best Practices Guide for Self-assessment and Continuous Improvement of Nuclear Criticality Safety Programs* in performing self-assessments.
Department of Energy sites welcoming external feedback, such as assistance and guidance from the CSSG.