June 20, 2019

To: Angela Chambers, Program Manager, US DOE Nuclear Criticality Safety Program (NCSP)

From: D. G. Erickson, Chair, US DOE NCSP Criticality Safety Support Group (CSSG)

Subject: CSSG Tasking 2018-01 Response

Approved Criticality Safety Support Group (CSSG) Tasking 2018-01 was initiated to address training requirements for personnel responsible for providing effective communication and an efficient interface between the operations/production organization and the criticality safety engineering organization. In some organizations, managers and supervisors have found it useful to assign some or all of these functions to individuals referred to as Criticality Safety Officers (CSOs).

The CSSG subteam was comprised of the following members:

- Mikey Brady Raap (Team Leader)
- Bob Wilson
- Fitz Trumble
- Jerry Hicks
- Jerry McKamy (CSSG Emeritus)
- Doug Bowen (NCSP Program Execution Manager)

The attached CSSG Response represents a consensus of the CSSG.

Six specific recommendations are included. The CSSG concluded that the best way to deliver baseline training to staff serving a CSO function would be to integrate CSO-focused training objectives into the existing manager's course

Cc: CSSG Members
CSSG Emeritus Members
D. Bowen
L. Scott

Attachment 1: Response to CSSG Tasking 2018-01

CSSG TASKING 2018-01
CSSG Recommendations for CSO Training

June 20, 2019

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CSSG Recommendations for CSO Training

Executive Summary

Integrated Safety Management Principles and long-standing good practice require that line management be responsible for safety of their operations. Indeed, line management is responsible and accountable for all aspects of their operations. In an era of ever escalating requirements, some sites have found it helpful for line management to delegate some portion of their responsibilities and authorities in criticality safety to specialized positions called Criticality Safety Officers (CSOs). CSOs usually report to line management and support line management in fulfilling their nuclear criticality safety responsibilities but do not in any way abrogate line management's responsibility and accountability for the criticality safety of their operations. Sites that have successfully implemented CSOs include Rocky Flats, Oak Ridge Y12 Facility, Savannah River and the Idaho National Laboratory (INL).

The position of a CSO is nowhere described in any American National Standards Institute/American Nuclear Society Series-8 Standard (ANSI/ANS-8), or Department of Energy (DOE) Order or Rule. Similarly, there is no standard set of roles, responsibilities, authorities and accountabilities assigned to the position of CSO. Finally, there exists no formal core training applicable to such a position that is applicable to what has been observed as best practices for CSOs.

The Criticality Safety Support Group (CSSG) has undertaken to put together a core set of competencies for the most commonly accepted responsibilities for CSOs with a view of incorporating training in these competencies as part of the Nuclear Criticality Safety Program (NCSP)-sponsored hands-on training. The CSSG solicited and received input on what CSOs do and what training is needed from line management, practicing CSOs, and the Federal Criticality Safety Coordinating Team (CSCT). The CSSG brought their considerable body of experience to interpret this feedback and apply it to developing a set of competencies. The CSSG recommends that the NCSP Hands-On Managers Course be revised to include several CSO-specific modules covering the following topics:

1. DOE Orders and National Standards,
2. Overview of Process Hazards Identification and Analysis,
3. Overview of the Criticality Safety Evaluation Process,
4. Review of Lessons Learned from Specific Historic Criticality Accidents,
5. Participation in Hands-On Critical Assemblies and Witnessing a Prompt Criticality,
6. Incorporating Human Factors into Procedures and Postings, and
7. Use and Limitations of Non-Destructive Assay (NDA) for Criticality Safety.

The CSSG assumed for the purposes of this Tasking that a CSO is a support role in carrying out Line Management's responsibilities for nuclear criticality safety. In no case herein is it to be construed that the terms CSO and CSE (criticality safety engineer) are synonymous.

Furthermore, the CSSG recommends that Line Management clearly define the role, responsibility, authority and accountability (R2A2) for the CSO such that the CSO function does not encroach upon the R2A2 of the CSE nor usurp accountabilities and authorities of Line Management for safety.

Background and Approach used in Assessment

Approved CSSG Tasking 2018-01 was initiated to address training requirements for personnel responsible for providing effective communication and an efficient interface between the operations/production organization and the criticality safety engineering organization (Attachment 1).

The ANSI/ANS-8 standards identify responsibilities for implementing a criticality safety program including identifying organizational roles and responsibilities. The standard defines operations managers and supervisors (line management) as well as the Nuclear Criticality Safety (NCS) organization responsibilities. Figure 1 is a depiction of the flow of the nuclear criticality safety implementation process and identifies the accountable organization per ANSI/ANS-8.19. ANSI/ANS-8.19 states that "Management shall assign responsibility and delegate commensurate authority to implement established policy." They may do this through the position of a CSO in whole or in part for the functions shown in Figure 1. Current practice varies across the DOE complex. A key challenge in the utilization of a CSO is to ensure the CSO has the training appropriate to assigned responsibilities to be successful. Care should be taken to clearly define the R2A2 of the CSO and align training in accord with the Integrated Safety Management principle of "competence commensurate with responsibility." At a higher level, we want to emphasize that delegation of responsibilities to a CSO in no way abrogates management's accountability for implementation of the criticality safety program. Integrated Safety Management Principles and Functions apply at all DOE sites and these are harmonious with the requirements of ANSI/ANS-8.19.

The concept of CSOs has not been adopted at all sites across the DOE complex. However, there are some organizations, managers and supervisors that have found it useful to assign some or all of the interface functions identified in Figure 1 to individuals often referred to as CSOs.

The CSSG felt it was imperative to reach out to practicing criticality safety professionals to get their perspective on the training requirements to perform the role of the CSO. Attachment 2 includes the memorandum that was used to solicit input. A description of the interface function and five basic questions were put forth in the memorandum:

- Please describe how your organization involves productions/operations staff and criticality safety staff in the execution of these responsibilities.
- What tools or background knowledge would benefit staff responsible for performing these responsibilities?

- What specific topics would be helpful for individuals tasked with the interface function?
- What training in these areas is provided at your site?
- Does your site have a specific position (full or part time) assigned the duties in Figure 1?

The feedback (summarized in Attachment 3) received from the practitioners was both comprehensive and diverse thereby highlighting the fact that there is no ANSI/ANS standard for a CSO role or responsibilities in the criticality safety process. Specific individuals and organizations solicited are identified in Attachment 4.

The Assessment Team determined that the most logical approach would be to review and organize the knowledge/training feedback into categories with specific learning objectives. Comparing these with existing training, utilizing the CSSG aggregate experience and striving to identify where the NCSP could add value over onsite training. The CSSG has included a table of learning objectives to include in NCSP sponsored courses for the CSO function.

The possible CSO functions indicated in Figure 1 are then reviewed and the appropriate knowledge categories necessary for the performance of that function are identified.

It would not be appropriate or even possible for the NCSP to provide 100% of CSO training. There are knowledge and training requirements that are more appropriately addressed onsite. These are discussed and recommendations are provided for content.

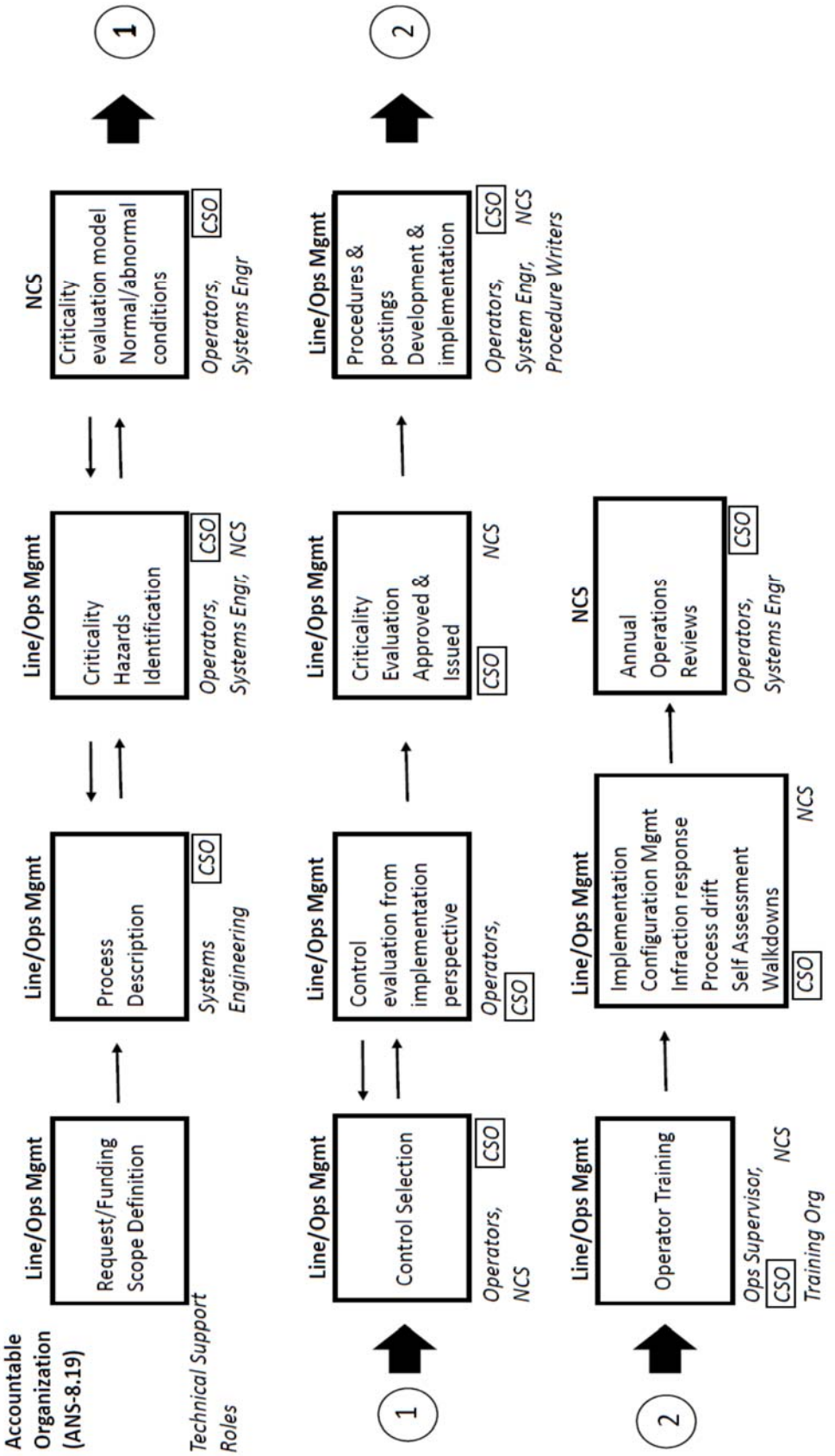

Figure 1. Nuclear Criticality Safety Implementation Process/Responsibilities

Assessment Team
The members of the assessment team were:

Mikey Brady Raap, lead
Doug Bowen
Jerry Hicks
Jerry McKamy
Fitz Trumble
Bob Wilson

These individuals have significant experience in the management, execution and oversight of criticality safety programs across the DOE complex. Biographies on the above team members may be located on the internet at the following address: https://ncsp.llnl.gov.

Discussion and Recommendations

In addition to the various inputs received in response to the solicitation questionnaire (Attachments 5-8), the tasking group reviewed other documents such as the Rocky Flats CSO Qualification card and the training materials used by Bechtel for CSOs at K25 projects. This section presents discussion and recommendations of on the significant training topics related to CSOs. Many of the topics cited are addressed/introduced in both the two-week NCSP Criticality Safety Engineer and the three-day NCSP Managers Training courses (See https://ncsp.llnl.gov).

With respect to **DOE Orders and National Standards** significant to the role of the CSO, the perspective of the Manager's Training course is most closely aligned with the level of detail and responsibilities described for the CSO/interface function. This information is not site-specific and should be presented carefully to avoid inadvertently adding "interpretation" to the standards. Also, the NCSP has instructors who have been directly involved in the development of the standards as well as the DOE Orders. This course content should go into some detail towards defining the terms "unlikely" and "credible" as they apply to the discipline of criticality safety and differentiated from the same words used routinely in nuclear safety analysis.

The **Overview of Process/Hazards Analysis (HA)** should include practical examples of Hazards Identification and Analysis techniques and their strengths and weaknesses. These analysis techniques are identified in the NCSP 2-week course. Those materials should be used for consistency. Additional information/references on HA methods should be considered as a resource to both CSOs and CSEs. Introduction to the fundamentals and theory should be addressed to the extent they support the hands-on training and the general concepts to assess the potential of a criticality accident. Emphasis should be placed on determining the credible upsets that could result in a criticality accident with specific input from operators. The CSO can add considerable value to this function by being part of the team identifying the various scenarios and determining which of these are credible and thus

to be addressed in the criticality safety evaluation. The application of such terms as 'likely', 'credible', 'unlikely', and 'beyond credible' in the criticality safety context should be included. The importance of a team approach including supervisors, operators, engineering personnel, criticality safety personnel should also be emphasized.

A detailed **Overview of Nuclear Criticality Safety Evaluations (NCSE)** is incorporated in the NCSP 2-week class. Dependent on the responsibilities and number of CSOs at a site this could be appropriate. However, for CSOs physically in an Operations/Production organization whose primary responsibility is guiding the implementation of the criticality safety program, the level of detail may not be appropriate or may not warrant the investment of 2 weeks. Two essential aspects of a criticality safety evaluation are determining the credible upsets that can cause a criticality event and determining the limits and controls that manage the risk. Basic theory to the risk for criticality and credible upsets should be favored in the Process/Hazard Analysis Module. The CSO role in understanding/aiding user-friendly control selection and implementation should be favored in this module. Discussions should include what to look for in operations, walk-downs and monitoring changes in the system configuration in order to maintain NCSEs. The CSO should understand the evaluation process to the extent they need to recognize when a condition or change should be confirmed or re-evaluated.

The NCSP has the unique expertise to provide a targeted **Overview of Selected Criticality Accidents.** Both the 2-week course and the manager's course include comprehensive overviews of the history of criticality accidents. Again, the CSO would benefit from a review of those accidents whose cause was related to a loss of configuration control, process/operation drift, and/or unprotected assumptions such as the process criticality accidents that occurred at JCO in Tokai, Japan, Y12, Los Alamos National Laboratory (LANL) and Hanford. A review of the JCO accident is recommended to be highlighted. General information about accident history should focus on common causes of the accidents.

A **Hands-on Demonstration** is essential to training CSOs. Again, both the 2-week and managers' courses offer hands-on demonstrations. The hands-on content of the 2-week course is too involved for most CSOs. Demonstrations that illustrate the effects of criticality safety parameters such as reflection, moderation and enrichment are essential to enable CSOs to visualize and question how these parameters can affect criticality safety in an operations/production environment. In addition, a hands-on demonstration simulating the effects of a criticality accident is needed. The discussion with this demonstration should emphasize that the impact of a criticality accident is to the immediate worker and not to the public. Use the actual history of criticality accidents to show how even co-located workers have survived because of prompt evacuation.

Human Factors is an important topic for CSOs, especially as it relates to control selection and providing effective postings. The recommendation here is to provide a focused, practical presentation on do's and don'ts of postings and how incorporating human factors can improve effectiveness and safety. Instruction on how to translate 'criticality engineer speak' into 'operator speak' in procedures and postings should be given with some specific

examples and practical exercises. CSO's should be trained to avoid over-specification of controls in procedures and postings and to avoid incorporating controls that have no impact on the reactivity of the system.

NDA Experience in Criticality Safety is a topic that is addressed in the 2-week course. The difference between NDA for nuclear materials accountability and criticality safety should be included as well as examples of criticality problems that have resulted from over-reliance upon nuclear materials accountability for tracking fissile material. A review of where issues related to NDA have resulted in criticality non-compliance or violation should be provided. The module for the CSOs should be somewhat shorter than the module provided in the 2-week course.

Table 1 is a summary of the recommended learning objectives to support the CSO roles that could be efficiently and effectively provided by the NCSP. This NCSP training is intended to complement and supplement, not replace, site-specific training for CSOs.

Site Specific Information and Training

Certain areas of CSO training are best left to the site-specific training teams, although some of them might be discussed briefly in the NCSP Managers Course. These include:

- Operations management responsibility to identify specific on-the-job training for each facility.
- Fire protection and MC&A programs applicable to the CSO area of responsibility where appropriate.
- Criticality accident alarm systems (CAAS), to include when needed, how they work, their basis for placement, and conditions which could impact the ability of the CAAS to detect events as anticipated.

The following list of topics should be left entirely to the site-specific training program:

- Nuclear criticality safety policy
- CSO responsibilities
- Nuclear criticality safety implementing procedures
- Infraction response, classification and reporting
- Continued on-the-job training
- The role of CAAS and what should CSOs know and be able to communicate about it.

Given that ANSI/ANS-8.19 permits the Manager to assign responsibilities as they see fit, it seems prudent to identify the CSSG recommendations for the individual CSO functions. Table 2 documents knowledge requirements for specific CSO process functions.

Table 1. Recommended Learning Objectives to Support CSO Roles

Knowledge Category	Learning Objectives
DOE Orders and National Standards	Introduce DOE O 420 and DOE STD 3007 ANS-8.1 Ownership of safety; Process Analysis; Double Contingency; Engineered vs. Administrative Controls ANS-8.19 Elements of good postings, fissionable material labels, and procedures ANS-8.23 Planning, Drills and Exercises, Evacuation zones ANS-8.3 Introduce criticality accident alarm systems, not one and done analysis, future changes could impact need
Overview of Process/Hazards Analysis	ANS-8.1 Process Analysis physics concepts Options for hazards analysis Importance of a team approach and configuration management Criticality Safety Application of "unlikely" and "credible."
Overview of Nuclear Criticality Safety Evaluations (NCSEs)	Criticality Safety Evaluation Model Control Selection Procedure development Development of Effective Postings Interface of criticality safety and DSA/TSRs Avoiding "infraction traps"
Overview of Selected Criticality Accidents	JCO accident as related to process drift CONOPS and Configuration Management in Y12, LANL, and Hanford Accidents Localized Nature of Consequences
Hands-on Demonstrations	Demonstrate effect of separation Demonstrate effect of reflection Demonstrate effect of moderation Demonstrate effects of criticality accident, impact to worker versus public
Human Factors	Impact of human factors on effectiveness of postings, procedures and behavior/judgement of operating personnel Summarize/cite occurrences that may have been avoided with increased emphasis on human factors and good communication
NDA Experience in NCS	Define methods of NDA used to support criticality safety Provide examples of how NDA has been used in the implementation of criticality safety programs. Include examples of concerns, occurrence reports that involved failures of NDA and examples of success integrating NDA controls Discuss differences between MC&A and Criticality Safety objectives in an NDA program

Table 2. Knowledge by CSO Role/Function

KNOWLEDGE CATEGORY / PROCESS FUNCTION	DOE Orders and National Standards	Overview of Process/Hazards Analysis	Overview of the Nuclear Criticality Safety Evaluation Process	Overview of Selected Criticality Accidents	Hands-on Demonstrations	Human Factors	NDA Experience in NCS	Site Specific Training
Scope Definition								X
Process Description		X						X
Hazards Identification	X	X	X	X	X			X
Evaluation Model	X	X	X		X			X
Control Selection	X	X	X	X	X	X	X	X
Control Evaluation	X					X	X	X
Criticality Evaluation	X	X	X	X	X			X
Procedures/Postings	X			X		X	X	X
Operator Training	X				X		X	X
Program Implementation	X			X	X	X	X	X
Operations Reviews	X	X	X	X	X	X	X	X

Recommendation 1:

The CSSG recommends that Line Management clearly define the role, responsibility, authority and accountability (R2A2) for the CSO such that the CSO function does not encroach upon the R2A2 of the CSE nor usurp accountabilities and authorities of Line Management for safety.

Recommendation 2:

An individual who performs more than one of the process functions indicated in Table 2 should train to all applicable knowledge categories for each of those functions.

Recommendation 3:

An individual, assigned responsibilities for a majority of process functions indicated in Table 2, should at a minimum participate in the NCSP Manager's course.

Recommendation 4:

The CSSG recommendation to the NCSP is to develop CSO-specific training modules to fulfill the learning objectives identified in Table 1.

Recommendation 5:

Due to the need for Hands-on Demonstrations for several of the CSO functions and the relatively small number of CSOs across the DOE, the NCSP should consider integrating the CSO modules into the existing NCSP Manager's Course, with breakout sessions for NDA and Hazards Analyses. Breakout sessions should be considered for other topics where specific focus is required for the CSO functions.

Recommendation 6:

The CSSG recommends that training developed by the NCSP be provided to the CSSG for review.

Conclusion

There were a range of responses that included; adequate training exists; the burden of existing training (2-week course) is high and some mobile or video demonstration would be an improvement; and this doesn't apply to us, "we don't have a CSO position".

The task team concluded that the best way to deliver training to staff serving a CSO function would be to integrate this training into the existing manager's course. Some sessions (primarily NDA and hazards analysis) should be added as breakout sessions from the rest of the manager's course.

Integrating within the Manager's course should allow the program to differentiate the CSO role, get some interaction between personnel with different responsibilities in criticality safety, and assure consistency on major issues like what the standards actually require. It could also benefit CSO attendees if their sessions could be concentrated within the 3-day Managers Course to reduce their training burden.

Clearly, some needs are site specific and should not be incorporated into a complex-wide training program beyond the introductory level. The value-added of an NCSP CSO course should focus on hands-on training to emphasize/demonstrate fundamental physics and conditions that may be encountered in the field.

A CSO program, if properly implemented and used, can result in qualified personnel to fulfil a vital leadership function to ensure good conduct of operations.

Attachments

Attachment 1 – CSSG Tasking 2018-01

CSSG Tasking 2018-01

CSSG TASKING 2018-01

August 22, 2018

Task Title:

Educational/Training for Improving Effectiveness of NCS interface with Operations/Production

(aka Content for NCSP class for Criticality Safety Officers)

Task Statement:

A number of functions within a healthy Criticality Safety Program are specifically dependent on effective communication and an efficient interface between the operations/production organization and the criticality safety engineering organization.

These functions include but are not limited to:

- Criticality safety program implementation – understanding limits and their basis including the hazard analysis, writing/reviewing appropriate procedures/postings supporting those limits and controls. Performing verification reviews that the limits/controls/equipment/postings are adequate, accurate and effective for operations to do work.
- Assessing process drift – how to evaluate activities within the process against the process description and the assumptions in the criticality safety evaluation (CSEs) (not just during annual operations/production (OPS) reviews). This includes supporting the hazard assessment portion of the CSEs.
- Annual operations reviews – how to effectively perform a meaningful OPS review as part of a team – what criticality safety related items should be looking for during these walkdowns? How best to provide value added comments to the OPS review documentation? How to ensure follow-up of commented items with management?
- Infraction grading and response – how to help operations determine (with criticality safety engineer support) the implications of a mis-step or unintended operation or discovery.
- Understanding of roles and responsibilities - standards and orders that directly impact operations/production (e.g., Supervisor responsibilities within 8.19; procedure and posting requirements)
- Coordination the team hazard assessment part of the criticality safety evaluation.

In some organizations, managers and supervisors have found it useful to assign some or all of these functions to individuals referred to as Criticality Safety Officers (CSOs).

The CSSG is tasked to develop the outline of a projected NCSP course for improving this interface. This task should include:

- Discuss and solicit feedback from practicing operations/production staff responsible for the interface with criticality safety to identify elements and possible sources of training materials

- Solicit feedback from criticality safety managers and operations/production managers to determine conditions where improved communication between operations/production and CSEs could have benefited their program and how to facilitate improvements
- Review existing materials from NCSP CSE training courses, NCSET modules and site CSO training materials to identify those specific to the interface functions
- Identify any missing elements
- Identify appropriate information to fill these gaps
- Develop the outline of a curriculum to address the functional needs to enhance the operations/production/CSE interface (aka the CSO role) and, in addition, provide an overview of the criticality safety discipline, resources, and standards.
- Determine the extent of hands-on demonstration needed.

Resources:

CSSG Task 2018-01 Team Members:

Mikey Brady Raap (Team Leader)
Bob Wilson
Jerry McKamy (CSSG Emeritus)
Jerry Hicks
Fitz Trumble
Doug Bowen (NCSP Program Execution Manager)

Contractor CSSG members of the team will use their NCSP CSSG support funding as appropriate; DOE CSSG members of the team will utilize support from their site offices.

Deliverables:

1. Develop task list and assign responsibilities to individual task members: August 15, 2018
2. Initial telcon: August 24, 2018
3. Written inquiries to NCS managers, CSOs, Operations/Production managers: August 31, 2018 (Request response by September 12, 2018)
4. Draft summary of training elements to enhance/inform interface for internal discussion: September 14, 2018
5. Follow up with NCS managers, CSOs: September 17, 2018
6. CSSG Subgroup to provide draft letter report to full CSSG for review: October 8, 2018
7. Full CSSG to provide review comments to Task Team Leader: October 22, 2018
8. CSSG team to issue final report to NCSP Manager: October 31, 2018

Task Completion Date: October 31, 2018

Signed: Angela S. Chambers

Angela Chambers, Manager, US DOE NCSP

Attachment 2 – Solicitation Questions

Dear Colleague,

The Department of Energy's Criticality Safety Support Group (CSSG)[1] has been tasked under the Nuclear Criticality Safety Program (NCSP) to solicit input and develop training recommendations to support and enhance the relationship between production/operations activities and site Criticality Safety Programs.

You have been identified as a person interested in the subject matter below by attendance at a past NCSP course or because one or more of the CSSG members has worked with you in this area in the past.

A number of functions within a healthy Criticality Safety Program are specifically dependent on effective communication and an efficient interface between the operations/production organization and the criticality safety engineering organization.
These functions include but are not limited to:

- Criticality safety program implementation – understanding limits and their basis including the hazard analysis, writing/reviewing appropriate procedures/postings supporting those limits and controls. Performing verification reviews that the limits/controls/equipment/postings are adequate, accurate and effective for operations to do work.

- Assessing process drift – how to evaluate activities within the process against the process description and the assumptions in the criticality safety evaluations (CSEs) (not just during annual operations/production (OPS) reviews). This includes supporting the hazard assessment portion of the CSEs.

- Annual operations reviews – how to effectively perform a meaningful OPS review as part of a team – what criticality safety related items should be looking for during these walkdowns? How best to provide value added comments to the OPS review documentation? How to ensure follow-up of commented items with management?

- Infraction grading and response – how to help operations determine (with criticality safety engineer support) the implications of a mis-step or unintended operation or discovery.

- Understanding of roles and responsibilities - standards and orders that directly impact operations/production (e.g., Supervisor responsibilities within Standard ANSI/ANS 8.19 and procedure and posting requirements)

- Coordination the team hazard assessment part of the criticality safety evaluation.

[1] https://ncsp.llnl.gov/

If you would be willing to help us with the knowledge base needed to develop this training, please answer the following questions. Coordination with other folks at your site is appreciated, but is at your discretion.

1. Please describe how your organization involves productions/operations staff and criticality safety staff in the execution of these duties.

2. What tools or background knowledge would benefit staff responsible for performing these duties?

3. What specific topics would be helpful for individuals tasked with the interface function?

4. What training in these areas is provided at your site?

5. Does your site have a specific position (full or part time) assigned the duties in the bullet list at the top of this document?

We appreciate your assistance and the time you have generously put into responding to this request. The goal is to improve the effectiveness and value of criticality safety programs throughout the DOE complex.

Please provide your responses by November 9, 2018

Please direct any questions/concerns about this inquiry to [*sic* Jerry McKamy (for Production/Ops Managers, Jerry Hicks (for Criticality Safety Officers), Bob Wilson (for Nuclear Criticality Safety Managers or Michaele (Mikey) Brady Raap (task lead)].

Thank you again for your assistance.

CSSG Tasking 2018-01 Team
Michaele Brady Raap
Jerry Hicks
Jerry McKamy
Fitz Trumble
Bob Wilson

Attachment 3 – Summary of Solicitation Responses

The individuals and organizations that were included in the solicitation are listed in Attachment 4. This attachment is a summary of the feedback from the different groups solicited.

Practicing Criticality Safety Officers

Four responses were received from three organizations. The direct feedback received is included in Attachment 5 for each of the questions included in the solicitation. There was a large variation in the responses indicative of the diversity of responsibilities at each site. In one case, the role of the CSO in training was emphasized. Several acknowledged the importance of the integration of operations and NCS. Integration with other disciplines like safety basis, fire safety, MC&A, and con-ops was also mentioned. A plethora of general topics were suggested in each of the responses. In the aggregate, all the topics addressed in the NCSP 2-week course were cited. The topics and diversity of responses are consistent with the main body of this report.

Detailed training information for CSOs including presentations and qualification requirements were provided organizations providing criticality safety support for K-25/K-27 Decontamination & Decommissioning activities. Hanford (CH2MHill) also provided documentation of their qualification requirements for the CSO position. The NCSP Training developers are highly encouraged to review and utilize this material to the extent possible.

Nuclear Criticality Safety Managers

Ten replies were received from 8 organizations including: LANL, LLNL, PNNL, SNL, INL, and Y-12. The direct feedback is included in Attachment 6. One of the replies expressed the preference that NCS and Operations remain separate and an interface role would not be helpful. One had just two engineers and they were responsible to assure the functions listed in the request were implemented.

All the rest specified that training in Hazard Analysis (some said Hazard Assessment or Scenario Development) was essential to the interface function. One noted that absent a competent HA, NCS engineers were apt to add controls to evaluations to cover the unknown and could add unnecessary restraints. Another noted that Criticality Safety specific HA was needed as the HA practiced by Nuclear Safety staff was focused on off-site consequences and often missed scenarios relevant to NCS.

SRS provided detailed information about CSO qualifications at their site with their response. NCSP training developers should review this detailed information as they move forward.

Other training topics recommended were:

- Conduct of Operations (2)
- Material Control and Accountability (MC&A) (2)
- Accident history (2)
- Information on relevant upsets in our industry (2)
- Familiarity with helpful documents (ARH-600, NCSP website documents) (2)
- Familiarity with ANS 8.1, including its limits, and ANS 8.19 (4)
- NCS controllable features (e.g. MAGIC MERV) (2)
- NCSP hands on course (1)

Productions and Operations Management

The detailed responses to the questionnaire from Production/Ops are included in Attachment 7. We only got two responses as far as we can tell. One was from an individual at Y12 who is indeed in Production but her role is to manage the CSO's so the feedback is basically from CSOs at Y12, not from an Ops/Production Manager viewpoint.

The other was from INL where the response was basically, "we got this covered with our onsite qualification course and the currently available short courses and the hands-on courses.'

A common thread from both might be the utility of the hands-on course insofar as actually showing students a prompt critical condition and also how little it takes to go from subcritical to critical. There seemed to be a hint of the age-old indicator of "It Can't Happen Here".

INL's response indicated that they are very confident in how their system is working. It would probably benefit the NCSP training developers contact them and get their program to review as a best practice.

CSCT Feedback

The Criticality Safety Coordinating Team (CSCT)* consists of federal DOE Headquarters and Field Office criticality safety subject matter experts. The CSCT is chartered to:

- Promote consistent nuclear criticality safety (NCS) program oversight
- Share NCS program information
- Communicate lessons learned from throughout the DOE complex
- Provide technical assistance and mentoring from senior NCS staff
- Assist in the field implementation of NCS improvements

The questionnaire was provided to all members of the CSCT but only one response was received. The response given in Attachment 8 was received from PNNL.

*See https://ncsp.llnl.gov/csct.php

Attachment 4 – Names and Affiliations of Personnel Solicited for Input

Group	Individual Solicited	Organization	Received Response from Individual	Received Response from Organization
Production or Operations Managers				
	Derwin W Gould	CNS		
	Robert A. Henry	CNS		
	John A Krepps	NPO		
	Kyle B Miller	Urenco		
	Summer S Mattmann	CNS		
	Sean S Cunningham	INL	x	x
	Elaine T. Marshall	SNL		
	Adam M Farrow	LANL		
	James E Radle	ORNL	x	x
	Kelli Marlow	CNS	x	x
Criticality Safety Officers				
	Steve Sandoval	PPPO	x	x
	Herman Collins	LANL		
	Derek Hounshel	LANL		
	Arthur Crawford	LANL		
	Jesson Hutchinson	LANL	x	x
	Jose Rodriguez	INL		
	Gary Engelstad	INL		
	Kelli Marlow	CNS	x	x
	David Snell	INL		
	Julio Trujillo	LANL	x	x
	Eric Flynn	INL		
Nuclear Criticality Safety Managers				
	John Justice	PPPO		
	Donna D'Aquila	PPPO	x	x

	Jackie East	PPPO		
	James Michael Low	SRS		
	Jonathan Bricker	SRS		
	Bill Brasel	SRS		
	Spencer Jordan	CNS	x	x
	Kristen Wessels	CNS		x
	Kevin Reynolds	CNS		x
	William Crooks	LANL	x	x
	David Heinrichs	LLNL	x	x
	Todd Taylor	INL	x	x
	Mike Thieme	ICP		
	John Miller	SNL	x	
	Richard Montgomery	ETTP	x	
	Stan Love	Isotek	x	x
	Carol Cise	RL		
	Tom Goetz	RL	x	
	Kraig Wendt	Bechtel		
	Andrew Prichard	PNNL	x	x
	Ernest Elliott	LANL	x	x
	Eric Loros	NVO		
DOE Criticality Safety Coordinating Team (CSCT)				
	Kermit Bundle	distribution to CSCT members	Andrew Arend	PNSO

Attachment 5 – Detailed Responses from Practicing CSOs

Q1 Please describe how your organization involves productions/operations staff and criticality safety staff in the execution of these duties.

Response 1: The safety team annually reviews and approves the safety basis, DSA, etc. Criticality Safety Program and SSO are evaluated annually and triennially as prescribed, including facility walkdowns. The PNSO team meets regularly with the contractor Nuclear Operations division and criticality safety staff to discuss the state of corrective actions, upcoming facility mods, off-normal events, etc. A DOE facility rep is dedicated to the facility and conducts regular inspections, which sometimes include other site office staff, such as myself.

Response 2:
Operations/Production staff is integrally involved in the development of new Nuclear Criticality Safety Evaluations (NCSEs), and with the change process for existing evaluations. The process for requesting a new criticality safety evaluation, or for modifying an existing evaluation, is initiated by Operations personnel (e.g. facility or system owner), who then work directly with the Criticality Safety Engineer to thoroughly describe the operation (or modification), and to assist in identifying the possible contingencies.

Once the evaluation has been written (or modified), Operations/Production staff is part of the review chain prior to the documents approval. Upon approval of the evaluation, Operations personnel take the lead in developing new procedures (or modifying the existing ones) and training documentation, to ensure that all requirements are adequately flowed down into them.

Those documents are then reviewed by NCS personnel for accuracy, prior to their approval. For the implementation of a new or revised NCS document, an Implementation Manager is designated by the Operations/Production group, who coordinates bringing the various elements of the process together, and which culminates with an Implementation Walkthrough with the NCS Engineer who developed the document. Included in the Implementation process is the training (or re-training) of applicable personnel. After successful implementation of these controls, the Fissile Material Operation (FMO) is assessed on a routine basis (at least annually) by both Operations/Production personnel, and separately by the NCS staff.

In the case of an anomalous condition (off-normal condition or violation), Operations personnel are responsible for reporting, isolation of the area, any needed compensatory actions, and ultimately the recovery from the event.
They are also responsible for the development and completion of the applicable corrective action plan.

Response 3

- Criticality safety program implementation – At NCERC, the Fissionable Material Person-In-Charge (FM PIC) for the project works with management, the CSO, and CSAs to understand the limits and write the procedures which implement the criticality safety requirements and match the process description of the evaluation. The initial verification reviews are performed by the FM PIC and FMH personnel (and are communicated to the CSO).
- Assessing process drift – At NCERC, this is done by the FM PIC and FMH frequently (generally prior to any activity).
- Annual operations reviews – At NCERC, this is done with at least one operations person (FM PIC or FMH) and a CSA, but generally includes the CSO.

- Infraction grading and response – At NCERC, the potential infraction investigation is led by line management and will likely include an FM PIC and CSO in addition to CSAs.
- Understanding of roles and responsibilities – At NCERC, all of our roles and responsibilities are outlined in our implementation plan, which is approved by management.

Response 4

CSO conducts annual training. CSE revisions are briefed focusing on process and controls done by CSO. CSO ensures controls in a procedure. I think more is needed in the development showing "graphic death" or "severe deformation and long-term pain" training. Some gore and drawn out death type information to bring the reality home – since I think we are too far removed from a criticality accident and the "*it will never happen to me*" syndrome has taken hold.

Response 5
Validation sessions are an excellent example of operations involvement in the Criticality Safety process. Here the hands-on people provide valuable input into the development and refinement of criticality safety controls.

Response 6
Production/Operations are involved in the Hazard Evaluation for the development/revision of CSEs. Operations are reviewer/approvers to any change to the CSE and implementing documents (Y15-187) and along with production (Y15-232). Small Group Sessions are conducted with operations and production when CSEs are made effective.

Q2 What tools or background knowledge would benefit staff responsible for performing these duties?

Response 1:
The most useful right now would be having a staff member who is fully qualified in criticality safety. I am currently working on the TQP, but in the meantime PNSO/PNNL requires support from the ISC—currently Kermit Bunde. The practical aspects of performing walkdowns would be particularly helpful as well.

Response 2:

The following tools or background knowledge would be of benefit:

Infraction reporting process
Understanding of Criticality Safety Parameters (MAGIC MERV, MERMAID, etc..,)
Understanding of Double Contingency
DSA/TSR Requirements
Site and operations history, layout of buildings, overview of processes, project plans, and, NMC&A, Emergency, Pre-fire, and Fire Protection Programs
Familiarization with NCS evaluations and limits
Fundamentals and theory of NCS
Historical characterization of process equipment
ANS/ANSI-8 series standards
Work Control Process
Site Operations
NCS Policy

Experience in performing assessments.

Response 3
In our opinion the background includes neutronics, standards, accidents, site- specific implementation, general criticality safety training, rad worker, con ops, safety basis, training on job-specific criticality safety evaluations and procedures, etc.

Response 4
Need some videos for the flat top (spacing effecting criticality) and planet showing foils in movie can (subcritical) and then stacked and moderated – critical with foils left over. Visual items to re-enforce words usually helps much more than just words.

Response 5
Criticality Safety staff should be a well-rounded employee with a variety of work experience involving management, oversight and safety. I think having an initial and recurring qualification program (much like the RCT core program) would be beneficial for criticality safety oversight based on ANSI 8 and general industry safety standards focusing on criticality safety basics and covering issues (MNC's, DEF's) that have occurred at Y12 and other facilities since the previous training cycle. Criticality Safety Professionals should have at least a basic knowledge of nuclear, chemical and biological sciences. Have an intermediate to advanced knowledge of computer skills, conduct of ops and causal analysis/incident investigation. Have advanced knowledge on criticality safety with hands on experience, experience in project management or supervision as well as instructor experience would each be beneficial.

Response 6
A more detailed history in the revision log on safety documentation. A more accurate and up to date process description.

Q3 What specific topics would be helpful for individuals tasked with the interface function?

Response 1
Training/workforce development, including curriculum.

Response 2
Some knowledge of hazard analysis techniques, especially terminology that might be used in an analysis would be helpful to an individual participating in the last bullet. The coordination of the hazard evaluation is handled by NCS Engineers at PORTS and they do receive some training as part of NCS Engineer qualifications; operations personnel participating do not have training in these techniques.

Additionally, the following topics would be very beneficial to individuals performing these tasks.

- Mentoring by experienced NCS Engineers
- Actual time in building:
    - Observing operations
    - Practicing problem recognition
    - Performing simple Criticality Safety duties
- Understanding of USDOE Orders and Standards

- Contractor-specific Procedures
- Other applicable NCS documents.
- United States historical criticality accidents
- Foreign historical criticality accidents
- NCS Policy, details of CSO responsibilities, and NCS implementing procedures
- Criticality Accident Alarm System (CAAS)
- Elements of good postings and procedures
- Problem recognition and proper response to identified problems
- Developing Criticality Safety Documents
- Advanced Problem Recognition

Response 3
In our opinion, the important part of the interface function is to fully understand both the operations and criticality safety program. This includes understanding all of the aspects of the operations (all safety disciplines, not just criticality safety), understanding the goals of the operations, and fully understanding the process. Regarding the criticality safety program, it involves understanding the site program and how it aligns with the standards, then fully understanding how that is implemented at the facility level in integrated work documents, plans, and/or procedures.

Response 4
I do not know what will help. Production operations has to start stepping up and taking ownership – NCSE & CSO can continually coach and review in the field BUT it does not help if "ownership" doesn't exist. An example is the holdup.

Response 5
Causal analysis training, incident investigation, safety management, technical writing, project management, critical thinking, change control processes, auditing and communication.

Response 6
What is the expectation of the interface function? Is it what is specifically assigned in procedures or what anyone assessing believes should be happening?

Response 7
Listed below are suggested topics relevant for the CSO specific training class:

- Nuclear Criticality Physics (Nuclear Theory)
- NCS Fundamentals
    - Criticality safety parameters
    - Hands-On experiments/modules focused on criticality safety parameters
- Nuclear Criticality Safety Program Elements (Includes Conduct of Operations)
- Effective Communications
- Human Factors
- ANSI/ANS 8 Standards
- Regulatory Drivers and Safety Basis Requirements
    - DOE Order 420.1C Change 1, *Facility Safety*
    - DOE-O-426.2, *Personnel Selection, Qualification, and Training Requirements for DOE Nuclear Facilities.*
    - DOE STD 3007, *Guidelines for Preparing Criticality Safety Evaluations at Department of Energy Non-Reactor Nuclear Facilities*

  - Nuclear Criticality Safety Program (Example)
    - Program description/requirements, roles, responsibilities, authorities, and accountability of the NCSP for facilities.
    - Program implementing procedure

- Typical roles, responsibilities and duties (e.g. procedure reviews, yearly fissionable material walk-downs)
- Relation between criticality safety and other safety disciplines (e.g. safeguards and security)
- NDA Measurements
- Situational Leadership
- NCS interface with CSOs, operations, management
- Communication
- CSED development and implementation
- Emergency responses
- Potential process deviations response
- Implementation of criticality safety controls (e.g. criticality safety postings, procedures and training of operators)

Q4 What training in these areas is provided at your site?

Response 1
PSNO, the PNNL site office, is too small to have much local training. In conjunction with the Richland Operations Office and the Office of River Protection, training courses in the above areas are sometimes brought to the region (HAMMER training complex, Richland, WA). These courses are ad-hoc however, and not provided on any regular schedule. Most of our training is delivered through the Nevada Field Office and the DOE National Training Center near Albuquerque/Los Alamos.
[In other words, nothing in criticality safety]

Response 2:
NCS Manager training (also known as supervisory training) handles these duties in general terms, with the exception of the hazard assessment. General assessment training is also provided.

The Portsmouth Site is in D&D mode, although we do have a CSO program in place, the CSO program is not as robust as at some of the other sites within the Complex and the actual CSO duties at this site are limited in scope.

Training for the CSO's at the Portsmouth Site is not well established and consists primarily of three elements:

- Completion of Nuclear Criticality Safety for Managers (Site class)
- Completion of CSO Qualification Card
  - Mentorship of Senior NCS Engineer
  - 6-months in area
  - Participation in 4 NCS walkdowns w/qualified CSO or NCS Engineer
  - Sign-off by NCS Manager
  - Required Read

    - ANSI Standards
    - DOE Orders
    - NCS Documents
- Completion of all Site required classes for D&D workers

The CSO's at the Portsmouth Site are utilized primarily to support Criticality Incredibility through walk-downs, paperwork reviews and documentation.

Response 3
Facility-specific criticality safety training (developed by management and the CSO), FMH training, performance demo training (an evaluation in which work is observed and discussed), etc.

Response 4
There is a qualification cards for CSO – no "CSO SPECIFIC" classroom training, it is more OJT than anything else. Outside training is made available via the off-site "hands on NCS professional" training.

Response 5
Most of the recommended training is either available onsite or accessible at another DOE facility.

NCSE qual program
CSO qual program
STA qual program (shift technical advisor)
I don't know what others do

Q5 Does your site have a specific position (full or part time) assigned the duties in the bullet list at the top of this document?

Response 1
I am assigned criticality safety duties at 0.3 FTE, with an additional 0.1 FTE of my time dedicated to other tasks as part of the Nuclear Safety Team. The Nuclear Safety Team consists of three staff members, but I am the only one focusing on criticality. There is also one full-time facility representative dedicated to PNNL's HC-2 facility.

Response 2
We do not have a specific position assigned the duties in the bullet list. The duties are distributed as follows:

Criticality safety program implementation – This is handled by the operating group with NCS Engineering and CSO assistance. Although there is a specific group of personnel designated to administer the elements addressed within this bullet, and the manager of the group is ultimately responsible for the overall program implementation, there is not a single individual specifically assigned to oversee all these various aspects,

Assessing process drift – This element is addressed by the staff during the annual assessment process, but there is not a single individual specifically designated to monitor this issue.

Annual operations review – There are specific staff members who coordinate the Annual Assessment performed by the Operations group, and the Annual NCS Walk-Through program.

Infraction grading and response – This element is addressed within the process for developing Anomalous Condition Reports (reports addressing off-normal conditions) but there is not a specific staff member assigned to this task.

Understanding of roles and responsibilities – This element is overseen by the group's manager.

Coordination of the team hazard assessment part of the evaluation – This effort is managed by the Criticality Safety Engineer assigned to generate the assessment.

Response 3

- Criticality safety program implementation – ORM, FM PIC, and FMH
- Assessing process drift – FM PIC and FMH
- Annual operations reviews – FM PIC, CSO, and ORM (ORM is optional)
- Infraction grading and response – ORM, FM PIC, and CSO
- Understanding of roles and responsibilities – all.

Response 4
The bulleted list captures CSO and NCSE – but it is not housed in one position.

Response 5
Yes.

Response 6
I believe engineering, operations, and production are all responsible for the bullet list above.

Additional Notes:

Response 1
It should be noted that most activities at NCERC are different from the rest of the complex. The purpose of NCERC is to conduct critical and subcritical experiments. The process is different because we are executing experiments. The experiments are designed to provide data that help with computational methods and nuclear data improvements which span a wide range of k_{eff} values and energies using various reflector and moderator materials. The fact that this work is experimental and not a traditional "process" means that the folks involved will often care about all of the system parameters more than someone involved in true processing might.

Response 2
First, everyone must understand there are competing goals. The direction of becoming a "Value Streamed Organization" encourages personnel to try "new things" to improve outcome. This encouragement lacks the emphasis necessary to preclude individuals from understanding that changes must first be evaluated and thus NCS is reduced in importance and is not seen as inviolate. And there lies the starting point – everyone at the site needs instilled in them NCS is a rule, a way of work, something that is inviolate, a sacred cow – all the terms applicable as PES & value streaming work to undermine (not intentionally). Which drives a "back to the basics" class for everyone working in a MAA. The class needs to cover many basics such as CSE development and needs to drive home the reality of the aftermath of a criticality (up to and including potentially painful deaths and site closure by others). The more that can be conveyed in "shock" format the better. The current training covers the parameters controlled in general and a small practical (a starter). The other part,

is there is not an “advanced” training for supervisors to enhance their understanding. As for ANS/ANSI – as they are implemented through local documents – much is lost.

Response 3
The primary purpose of the CSO Program should be to enhance the safety culture with site specific Nuclear Criticality Safety (NCS) Safety Management Program and improve operational efficiency within their respective sites. The CSO should serve as a day-to-day technical liaison between the personnel of the NCS Divisions and facility, operations and support functions of each respective site. In accordance with DOE-O-426.2, CSOs are categorized as “Technical Support Personnel.” As with any safety discipline program, it is of utmost importance to provide CSOs with clear roles and responsibilities. It is also essential to provide CSO specific training that will allow them to perform their work efficiently, safely and securely and establish ways to measure the health and success of their respective CSO programs. In addition, CSOs should be familiar with all of the current as well as future operations in their areas.

Attachment 6 – Detailed Responses from NCS Managers

Q1 Please describe how your organization involves productions/operations staff and criticality safety staff in the execution of these duties.

Response 1: Operations (Facility Managers and Operations Supervisors) and Nuclear Criticality Safety (NSC) Engineers working under Isotek Systems LLC on the U-233 Disposition Project work very closely together. Each nuclear facility has trained and qualified Nuclear Facility Managers, Operations Supervisors/Fissile Material Handling Supervisors and Operations Technicians/Fissile Material Handlers. These personnel not only become proficient in understanding their facility operations, they also take classes regarding criticality controls associated with their facilities. These classes occur every time a Nuclear Criticality Safety Evaluation is develop or revised, but at least once every two years.

There is a specific Nuclear Criticality Engineer who is assigned to support Operations, though reports up through the NCS organization, who spends a significant amount of time in the field. This person understands the challenges of implementing requirements in specific operations and is able to take this information back to the NCS organization. The position is also the primary reviewer of all new and revised Operations procedures and work packages where key controls of the NCS programs are implemented. This unique skillset of understanding operations but being beholden to NCS creates a valuable asset to both organizations.

Response 2:

a. CSP Implementation – Hazard analysis is performed in a team approach involving NCS Engineers, Operations Staff, Safety Analysis Engineers, Design Engineers, and System/Process Engineers, as well as other safety professionals. The analysis process addresses the various aspects of a fissile material operation, usually taking a segment of the operation at a time. As various failures are considered, NCS Engineers consider implications to the NCS Evaluation and use these discussions to develop the assessment of normal and abnormal conditions. The evaluation of these conditions result in the suite of NCS controls applicable to the fissile material operation. The NCS Evaluation is then submitted to those involved in the initial hazard analysis, where it is reviewed for: (1) accuracy of the description of the fissile material operation; (2) completeness of the set of identified abnormal conditions; and, (3) understanding and feasibility of the set of engineered and administrative controls.

   Once the appropriate set of controls is established, Operations personnel develop procedures that incorporate the administrative controls, and Engineering personnel produce designs for engineered controls. NCS Engineers responsible for developing the NCS Evaluations review both design and procedures to ensure the controls are properly implemented. Operations personnel also develop posting language with the aid of NCS Engineers. NCS Engineers provide classroom training on each NCS Evaluation to Fissionable Material Handlers (FMHs) and Fissionable Material Handler Supervisors (FMHSs). This training includes a presentation of the evaluated normal and abnormal conditions, and the controls determined from the evaluation, including the affected parameters.

   An implementation checklist is used by NCS Engineers to confirm:

   - Design is implemented in the field;
   - Operating procedures have implemented NCS controls in a traceable manner;
   - Maintenance requirements for NCS engineered controls are properly specified with adequate periodicity;
   - NCSE training has been accomplished for FMHs/FMHSs; and,

- Postings have been placed in a visible location.

Implementation checklists are reviewed and signed by the responsible FMHS, once the field is ready to begin fissionable material operations.

Once fissionable material operations have begun, NCS Engineers monitor field operations to verify that controls are working as expected. No periodic schedule is developed for this monitoring, but in general, More frequent (daily to weekly) monitoring occurs at the beginning of any operation, and less frequent (monthly to bi-monthly) monitoring occurs as more experience is gained.

b. Assessing Process Drift – NCS Engineers perform surveillances of fissionable material operations, usually monthly or more frequently in times of new or relatively high activity. Isotek operates two nuclear facilities and an NCS Engineer is assigned as lead NCS representative in each facility and physically sits with the operating organization. As such, the NCS Engineer is responsible to:
    - Perform routine surveillances;
    - Review procedure modifications;
    - Review design modifications;
    - Deliver updated training on NCSEs;
    - Attend daily Plan of the Day meetings; and,
    - Respond to abnormal events affecting NCS.

    All of these activities require close coordination with Operations personnel and involve daily monitoring of activities that could impact fissionable material operations and effect process drift.

c. Annual Operations Reviews – Annual Operations Reviews are scheduled with the Facility Manager and coordinated with the FMHS for the fissionable material operation undergoing review. In addition to discussions with Operations personnel, and Annual Operations Review includes reviews of related previous surveillances, reviews of implementing documents, and observance of actual operations. Any concerns are addressed directly with Operations personnel participating and, as necessary, elevated to the Facility Manager. Any issues identified are tracked to resolution using the project's Commitment Tracking System, or if necessary, the issue is documented formally as a nonconformance.
d. Infraction Grading and Response – All operating infractions having NCS significance result in the engagement of both the NCS staff and the Operating organization. Together, these organizations assign the severity level of the infraction, and the appropriate response to the condition. If warranted by the nature of the situation, the FMHS directs operations to cease until the best course of action is determined by the NCS staff, the FMHS, and the Facility Manager.
e. Understanding Roles and Responsibilities – Roles and responsibilities for all personnel who implement or interact in some manner with the NCS Program are documented in procedures. Training is provided at differing levels, depending on the level of responsibilities, with FMHs, FMHSs, the Facility Manager, and other Operations personnel receiving the most rigorous NCS training offered. In addition, as indicated above, FMHs and FMHSs receive training on each NCS Evaluation covering the work that they perform.
f. Team Hazard Assessment – See response to Item a. above.

Response 3: Operations/Production staff is integrally involved in the development of new Nuclear Criticality Safety Evaluations (NCSEs), and with the change process for existing evaluations. The process for requesting a new criticality safety evaluation, or for modifying an existing evaluation, is initiated by Operations personnel (e.g. facility or system owner), who then work directly with the

Criticality Safety Engineer to thoroughly describe the operation (or modification), and to assist in identifying the possible contingencies.

Once the evaluation has been written (or modified), Operations/Production staff is part of the review chain prior to the documents approval. Upon approval of the evaluation, Operations personnel take the lead in developing new procedures (or modifying the existing ones) and training documentation, to ensure that all requirements are adequately flowed down into them.

Those documents are then reviewed by NCS personnel for accuracy, prior to their approval. For the implementation of a new or revised NCS document, an Implementation Manager is designated by the Operations/Production group, who coordinates bringing the various elements of the process together, and which culminates with an Implementation Walkthrough with the NCS Engineer who developed the document. Included in the Implementation process is the training (or re-training) of applicable personnel. After successful implementation of these controls, the Fissile Material Operation (FMO) is assessed on a routine basis (at least annually) by both Operations/Production personnel, and separately by the NCS staff.

In the case of an anomalous condition (off-normal condition or violation), Operations personnel are responsible for reporting, isolation of the area, any needed compensatory actions, and ultimately the recovery from the event. They are also responsible for the development and completion of the applicable corrective action plan.

Response 4:

- The NCS Program is responsible for developing the program requirements for the DOE Orders and ANSI/ANS standards. Implementation of the requirements are executed by both program staff and operation elements. The NCS Program current resides in the Facilities and Operations directorate with support of Criticality Safety Engineers (CSEs) in a research directorate, or contract CSEs that report directly to the program manager. Program staff include a program manager, CSEs and Criticality Safety Representatives (CSRs). The operations element consists of Fissionable Material Line Managers (FMLM), Fissionable Material Supervisors (FMS) and Fissionable Material Handlers (FMH). There are operating elements for two different research directorates as well as the Facilities and Operations directorate.
- At PNNL the FMS and CSRs are part of the interface between operations and the CSEs.
- The FMSs and CSRs are tasked with developing the operating documents and postings that contain the criticality safety controls.
- The FMSs and CSRs are involved in the development of the hazards analysis and limits with the CSEs.
- FMLMs take the lead in verification reviews that limits/controls/equipment/postings are adequately implemented prior to authorizing new activities. They periodically confirm that the controls are accurate and effective for operations. The CSEs will provide input as requested and will observe this activity occasionally.
- The FMSs with assistance of the CSRs implement the limits/controls/equipment/postings associated with a specific process or area. The CSEs will provide input as requested and will observe this activity occasionally.
- For process drift the Fissionable Material Supervisors are tasked with identifying changes to the equipment or processes and consulting with the CSR. The CSE is responsible for documenting that changes are within existing Nuclear Criticality Safety Evaluation (NCSE). This process works well for processes that are well defined and documented processes. For

evolving research activities under generic limits, identifying process drift is more problematic.

- As part of the development of the NCSE, both the FMSs and CSRs review the NCSE to understand the analysis and what controls are required. One expectation of the FMSs and CSRs is to look for implementation issues and traps.

Response 5:

a. The NCS engineers review all implementing documents to ensure requirements are implemented correctly (e.g. procedures, drawings, procurement documents, surveillances, and postings).
   NCS engineers lead the hazard analysis sessions with operations and engineering in the development of the CSEs, this process is now required where it hadn't been before.
   The CSOs perform a validation on the CSEs with operators after they have been drafted.
   The CSOs have small group seminars to ensure continuous training with the operators.
b. NCS is involved in the change control process for any change to the nuclear facilities. These changes should include operational changes in addition to physical modifications. NCS hazard evaluations are now performed before each CSE revision.
c. During operational reviews, NCS is reviewing the process to look for any drift or creep, as well as violations against existing requirements. Our operational review form has a section for "operational/equipment issues", anything listed in this section requires resolution or the comment is tracked in our plant issues tracking system.
d. NCS is the responsible organization for responding and grading abnormal conditions that occur. Operations reviews guidance to make sure it does not impact any other safety disciplines. An NCS procedure gives the criteria for reporting level of the issue and the NCS engineer/manager make the determination.
e. NCS just ensures all requirements are implemented correctly, don't know exactly what this item was getting at.
f. NCS engineers lead the hazard analysis sessions with operations and engineering in the development of the CSEs, this process is now required where it hadn't been before.

Response 6: N3B: Since this is a new program (that is not yet fully implemented) I can only speak to how we intend for these responsibilities to be carried out. The N3B program will involve operators early and often in these various activities, but especially the hazard analysis. N3B has a specific procedure for hazard analysis which gives the roles/responsibilities for all parties.

The N3B infraction response procedure also involves the operations personnel through securing the area, gathering information, and participating in the fact finding.

Assessing process drift can be done effectively by constant monitoring of operations, discussions with personnel, and ad hoc NCS training. This may be less of an issue for N3B operations (due to the nature of our operations), but we still need to be very careful and aware of it. Face time with operations staff and observing the operation will greatly help in this regard. Pre-job briefings, which we did at RFETS most of the time, will also help and N3B will pursue making this an integral part of the pre-job.

LANL: LANL has many of these same procedures, but they do not execute them effectively, especially the hazard analysis: no one took the time to do the analysis well and thoroughly. Many times it was very informal and not documented well (or at all).

At least a few times, LANL held fact findings for NCS infractions, but the opinions of operations personnel regarding the severity level were overruled by operations management/NCS management.

The annual operational reviews varied quite widely in terms of quality, and sometimes the knowledgeable operations personnel were not in attendance.

Process drift is another factor LANL had to deal with, and I did not see an effective solution to this issue while I was there. One of the real problems is that in almost every instance, the NCS analyst did not observe the actual operation while it was being performed.

Response 7: As a small site with limited Nuclear Criticality Safety (NCS) related activities and with both reactor and critical assembly operations, I feel are approach is unique/graded in our applications. In general, for each activity/facility we have an individual identified as the facility/activity supervisor. This position would be the closest in function to a CSO. Our approved site NCS program specifically assigns many of the above functions to line supervisors, some to managers, and a few to the workers.

On the NCS side, our team works closely with operations, both in the planning of an upcoming activity (campaign based) and the general programmatic implementation at the various locations. Note, we are a small site with

- no fissionable material solutions;
- well defined and limited scope general fuel handling/staging and support activities associated with reactor/experiment assembly operations;
- in general, all on-site staging and transportation are under CSI or below NCS threshold mass; and
- significant quantity processing activities are handled on a campaign basis such that they are limited in scope and are short duration.

This results in our small team being familiar with operations and to have the benefit of working fairly closely with them on all activities.

Response 8: Involvement of productions/operations staff is somewhat limited as there are essentially no field-implemented criticality safety controls. Criticality safety staff has primary responsibility for ensuring compliance with criticality requirements.

Training under ANSI/ANS 8.20 is a primary tool for ensuring operations staff understand criticality evaluations and control implementation processes. The training specifically addresses roles and responsibilities and provides opportunities for operations feedback.

Comprehensive document review processes ensure that criticality safety programmatic and control-implementing documents have thorough review by both operations and criticality staff. Criticality procedures direct the operations involvement in development of criticality evaluation.

Reoccurring updates to criticality evaluations ensure operations involvement in developing process descriptions and hazard evaluations input. Operations concurs with criticality safety controls.

Response 9: At LLNL criticality hazards are addressed as any other hazard through the work control/work authorization process, which relies upon the Responsible Individual (RI) and Authorizing Individual (AI). Per ES&H Manual, Document 2.1, “General LLNL Worker ES&H Responsibilities,” Paragraph 3.1.12: “The RI is the person directly responsible for an operation, activity, or group of activities. The RI may be at any level within the organization and is formally

identified by the activity's AI. The RI communicates ES&H expectations to workers on their activities and holds the workers accountable for their performance."

Per ES&H Manual, Document 2.2, "LLNL Institution-Wide Work Planning and Control Process," Paragraph 2.2: "The RI ... needs to ensure the identification, documentation, and analysis of the severity/significance of the hazards that could potentially adversely impact workers, the public, the environment, the facility and its equipment, or the mission."

As work involving fissionable materials is NOT commonly performed by the public, this work is work authorization level (WAL) B or C, which ensures involvement of the ES&H Team, SMEs, etc. Note that "Criticality safety is a key element of the Laboratory's Environment, Safety, and Health (ES&H) Program" – ES&H Manual Doc. 20.6, "Criticality Safety," Section 3.0. Further Doc. 20.6 states: "For activities requiring a criticality safety evaluation, the Responsible Individual (RI) shall ensure that a criticality safety evaluation is performed and documented in consultation with Nuclear Criticality Safety Division, the ES&H Team, and facility management." – Section 3.3.

Doc. 20.6, Section 6.1, identifies "The primary line of responsibility for criticality safety …. Extends from the … Director through the program PADs and facility associate directors (Ads) to authorized users who have hands-on responsibility for activities involving fissionable material."

Section 6.2 states "Within a program, the line of responsibility extends from the program AD to the program leader, principal investigator, or RI for that operation. The program AD (or designee) is responsible for ensuring that all ES&H requirements, including criticality safety requirements, are implemented in program activities." The designee is the RI.

In short, it is the productions/operations staff that formally ensures criticality safety staff are involved in their activities with fissionable materials. Not the other way round.

Response 10: Operations is the primary owner of the implemented criticality safety controls. As such they request assistance from other organizations as needed. This may be related to questions about some aspect of an operation, some off-normal condition response, the need to change/revise an operation, or to develop a new operation. The facility CSO/CSE is frequently a primary participant in any of these efforts.

Q2 What tools or background knowledge would benefit staff responsible for performing these duties?

Response 1: An in-depth knowledge of the nuclear facility operations, maintenance and the nuclear criticality evaluation key components are a must for both the Operations and NCS staff. The two groups must work from the same page. In addition, the more informed the NCS organization is on operational and maintenance challenges, the more supportive they can be in determining workable controls. Ultimately a field presence is key.

Response 2: It would seem that a useful tool would be a methodology that gets more at the NCS aspects of hazard studies. Most hazard studies are too generic to engender good cross-talk between the NCS staff and the Operations personnel. The hazard studies I have participated in usually are run by facility safety types with no experience in NCS Evaluation generation, so the questions asked don't really drill down into NCS specifics. Only the more senior NCS Engineer types who are willing to speak up in such a setting will facilitate a good review under those circumstances.

Response 3: The following tools or background knowledge would be of benefit:

- Infraction reporting process
- Understanding of Criticality Safety Parameters (MAGIC MERV, MERMAID, etc..,)
- Understanding of Double Contingency
- DSA/TSR Requirements
- Site and operations history, layout of buildings, overview of processes, project plans, and, NMC&A, Emergency, Pre-fire, and Fire Protection Programs
- Familiarization with NCS evaluations and limits
- Fundamentals and theory of NCS
- Historical characterization of process equipment
- ANS/ANSI-8 series standards
- Work Control Process
- Site Operations
- NCS Policy
- Experience in performing assessments.

Response 4:

- How to communicate the basis for the limits and how the hazards analysis and upset conditions influence the selected limits. Also, the concept that preferences in the conduct of operations and limits will impact the hazards analysis and upset conditions. (one version of on operations wants to use limited dimension containers vs an alternate operations wants to use moderation control result in two different upset condition sets)
- How to identify the differences between explicit controls (the spacing between units is 30 cm) and implicit controls (operations are assumed to use only vessels that are made of steel or glass).
- Strategies to identify implicit controls and how process drift could impact the hazards analysis and limits.
- Strategies to explain of how the events identified in a hazard analysis translate into modeled upsets, limits and controls.

Response 5:

a. Training on how best to perform NCS hazard evaluations.
b. Provide more details and examples on the expectations of the supervisor and operations management with respect to knowledge of NCS.

Response 6: First, knowledge of how the control set is derived, which involves understanding the hazard analysis as being the springboard for the NCS evaluation flight path. Training in hazard analysis techniques and high-level understanding of some of the basic ANSI/ANS Series 8 standards and associated requirements would also be helpful.

Training for the operations staff on the NCS evaluation, the controls, and the operations covered in the NCSE during the implementation process would also help people to be more aware of the operational boundaries, and perhaps recognize deviations more quickly.

The NCS analyst should be able to give training (i.e., has had courses on training and is a certified trainer), both formal and ad-hoc, when necessary.

Finally, there is no substitute for understanding the NCS program for the site (the requirements of the program and ***why*** these are ***requirements***), and understanding the operation thoroughly.

Response 7: Staff responsible for performing such duties would need to have a fundamental (not expertise) understanding of the programmatic NCS requirements (standards, orders, local practices, etc), as well the basic interfaces between NCS and line operations. Furthermore:

- Must have a fundamental understanding of what is a good safety culture, questioning attitude, ability to speak up and challenge the status quo, as well as to be able to build relationships and trust both on the floor and with the NCS team. ---- This interaction/communication is very important aspect of the job and the ability to speak NCS and operations and translate between goes a very long way to successful implementation. When I worked at places with CSO, those that were well informed from both sides and built trust on both sides were the ones that were successful and often lead to reduced re-work in evaluations.
- Encouraging and supportive of individuals coming forward to them with questions, concerns, thoughts about processes and controls (i.e., approachable). Essentially, be outgoing enough to encourage and get feedback on the things that could adversely or favorable affect NCS, as well as any potential improvements.
- Knowledgeable in aspects of NCS relevant to operations that they support. Understanding of the operational procedures, limits/controls, and other NCS considerations of the operations.

Response 8:
Knowledge of requirements, the importance of the requirements, and expectations for establishing compliance are key

Response 9: Fissile material handler certification
Senior fissile material handler certification
Time in grade and knowledge of other sites. Note that many LLNL handlers have extensive experience (and may be qualified FMHs) at LANL, PANTEX, NNSS. Others have experience at INL and SNL.

Response 10: First, all CSOs begin by achieving qualification as an ACSE. The ACSE documents knowledge of the following requirements or other types of documents. This is all documented on formal qualification cards, position orientation checklists, and required readings.

- A basic understanding of the site NCSEs
- Tours of some SRS facilities
- Review of some prior (site and/or facility) self-assessments
- ANS-8.1, .3, .7, .15, .17, .19, .22, .26
- DOE O 420.1, DOE-STD-3007
- ARH-600, LA-10860, LA-12808, LA-13638, LA-14244-M, TID-7016
- R. A. Knief, *Nuclear Criticality Safety – Theory and Practice* (select chapters)
- The SRS Criticality Safety Program Description Document, the SRNS Nuclear Criticality Safety Manual (select chapters), the SRNS Criticality Safety Methods Manual (select chapters)
- The SRS ISMS Description, the SRS Conduct of Operation Manual

The ACSE also takes a number of site specific courses, covering a broad range of topics, mostly related to different engineering and nuclear safety topics that are important for basic site support.

The CSO then documents knowledge of the following via documented formal qualification cards, position orientation checklists, and required readings:

- ANS-8.10, .14, .20, .21
- DOE G 414.1-1B, DOE O 425.1D, DOE-STD-1027, DOE-STD-1158, DOE-STD-1186, DOE-STD-3009, DOE-STD-3011
- INPO 05-002, NUREG/CR-6604
- the SRNS Nuclear Criticality Safety Manual (select chapters), the SRNS Assessment Criteria and Lines of Inquiry for the CSP, and the SRNS Management Assessment Procedure.

The facility CSO will also require facility specific training in areas such as:

- The facility DSA and TSR
- Documented walkdowns of the facility
- Other facility specific documents

Finally, the CSO goes through an extensive oral board that includes representatives from the facility (e.g., Engineering, Operations, Nuclear Safety), to ensure an adequate understanding of Criticality Safety, Nuclear Safety, and the facility, prior to providing the expected independent support.

Q3 What specific topics would be helpful for individuals tasked with the interface function?

Response 1: Conduct of Operations
Conduct of Maintenance
NCS Evaluations
Facility Tours (very important to see what operations is talking about)

Response 2: As the workforce matures, and the senior generation retires, a significant need will arise for training as newer personnel come into the NCS profession. Training with a focus on the interface role with Operations will be a continuing need and it would probably be useful to standardize the expectations in this area. The training should not be one-sided and be directed only at the NCS staff. Operations and Engineering should participate as well. Some ideas for specific topics:

- Performing effective surveillances.
- Suggested protocol for responding to infractions.
- Implementing and flagging requirements in design documents and procedures.
- Hazard evaluations specifically for NCS (See item 2 above).

Response 3: Some knowledge of hazard analysis techniques, especially terminology that might be used in an analysis would be helpful to an individual participating in the last bullet. The coordination of the hazard evaluation is handled by NCS Engineers at PORTS and they do receive some training as part of NCS Engineer qualifications; operations personnel participating do not have training in these techniques.

Additionally, the following topics would be very beneficial to individuals performing these tasks.

- Mentoring by experienced NCS Engineers
- Actual time in building:
  - Observing operations
  - Practicing problem recognition
  - Performing simple Criticality Safety duties

- Understanding of USDOE Orders and Standards
- Contractor-specific Procedures
- Other applicable NCS documents.
- United States historical criticality accidents
- Foreign historical criticality accidents
- NCS Policy, details of CSO responsibilities, and NCS implementing procedures
- Criticality Accident Alarm System (CAAS)
- Elements of good postings and procedures
- Problem recognition and proper response to identified problems
- Developing Criticality Safety Documents
- Advanced Problem Recognition

Response 4:

- A module for CSRs to develop a high level understanding of how to use ARH-600, or similar document.
- A module for CSRs on limits from the ANSI/ANS-8 standards and the conditions of for using those limits.
- Basic understanding of hazard analysis techniques and how they are applied to Criticality Safety.
- A module to provide CSRs a familiarity with the ANSI/ANS-8 series of standards.

Response 5:

a. Lessons learned on process drift/creep and recent DOE complex process upsets.
b. Mapping of NCS responsibilities given to the supervisor and operations management at each site.

Response 6: Someone who is responsible for interfacing needs to be aware of the operations perspective as well as the NCS perspective. He/she should probably take some of the courses that the operations personnel take, such as material accountability, CONOPs, etc. This would give them a much needed perspective on what the operations personnel deal with in performing the job and how NCS can be implemented more effectively.

Response 7: I'll try to highlight what I think here in a bullet list (not any specific order), but some of this is found in question 2 and 4:

- An understanding/overview (high-level) of regulations: from 10CFR to the site programmatic documents flow
- Some ANSI/ANS standards or parts of them (8.1, 8.19, etc) and how the site implements them. Much of 8.19 would be important.
- Very detailed knowledge of the NCS documents and Operational procedures/support documents for the areas they support. This means understanding the limits/controls and why they are what they are. Also means understanding the process flow (i.e., draw a box around the process and understand what can come into the box, what can leave the box, and what occurs inside the box.
- Must understand the processes surrounding the movement of, tracking of, and control of fissionable material in their area.
- A sound understanding for the MAGIC MERV and how it applies in field. They should be able to go to an activity and think through the various parameters, understand the controls in place and what the protect and what type of upsets impact them- looking for Process drift
- Training in hazard assessment, the importance of it, and how it is captured/used in NCS evaluations.
- Need to understand rules around what to do and who to inform if something is suspected or found to be amiss. Also empowered to take the appropriate action, without fear of being impugned
- Need to understand when they should obtain guidance from NCS engineers and who to contact for such guidance.
- Understanding of past accidents and my preference is near-misses or infractions (both local and from other sites). I know operations likes these almost more than the accidents and it sparks more discussions about our site then the accidents do.
- Should be trained to participate in the development of NCS-related procedures applicable to their operations.
- Some physics understanding of NCS and criticality. Basic, hands-on class for 1/M approach and at a high-level the kinetics behind criticality. Not all the math, but a feel for it.
- I think an understanding of not only the rules but also the politics (local) surrounding NCS and being able to help explain it and the importance of it to the line.

Response 8: Appropriate tailoring of the criticality safety program implementation when fissile material operations and concerns are limited.

Response 9:
No LLNL FMH or Facility Manager has taken the national NCSP one-week hands-on criticality safety course at NCERC or SNL due to the time required (one week rather than one day) and expense (not so much the cost, but time away from their duties). When the LLNL Training Assembly for Criticality Safety (TACS) was located in B332, one day practical training was offered illustrating controllable factors (mass, interaction, reflection, moderation, poisons) as a follow-up to the academic material in HS3100, Fundamentals of Criticality Safety. Since then, LLNL has developed the Inherently Safe Subcritical Assembly (ISSA) and is developing this as an internal training resource. Courses have already been provided to safety analysts, healthy physicists, NDA SMEs, and university students (UC-Berkeley).

Response 10: At SRS, while the Criticality Safety Engineer (CSE) program should be very similar to that at other sites, the Criticality Safety Officer (CSO) program is different than that understood to exist at other DOE sites. At SRS, the first level of qualification for a candidate criticality safety engineer is the Associate CSE qualification. Next, depending on facility/program needs, the

candidate pursues either the CSO or CSE qualification. Once this qualification is obtained (CSO or CSE), the candidate then pursues the other qualification (again, CSE or CSO). Finally, once the candidate has achieved these qualifications (ACSE, CSE, and CSO), the candidate can pursue a Senior CSE (SCSE) qualification. This progression is better understood by looking at Figure 3-1 (page 15 of 24) in the attached *CS Engineer Training & Qualification Program Description*. Therefore, at SRS, there is overlap between the two disciplines.

The combination of the CSO and CSE roles in this way leads to improvements for both functions. The CSO/CSE better understands the overlap between the CS and facility needs and can better ensure these needs are incorporated into the process evaluations, and the facility receives better support.

The CSE duties are generally related to the preparation of criticality safety evaluations. The preparation may include participation in the hazards evaluation of potential criticality scenarios, development of the SCALE/MCNP models and determination of ksafe and keff, development of limits, and participation in the selection of controls.

The CSO position has the more direct implementing responsibility. They are the primary CS interface with Engineering and Operations. The CSO will also participate with the hazards evaluation of potential scenarios and selection of controls. The CSO reviews and approves facility implementing procedures to ensure the needed CS limits and controls are appropriately implemented. The CSO performs facility surveillances, provides daily support to process operations to ensure compliance with criticality safety controls as well as responding to abnormal conditions, and provides expert guidance in meeting criticality safety controls.

As previously stated, there is some overlap in the CSE/CSO functions; in many circumstances the CSE and CSO at a facility are the same person, just performing the different roles as necessary. Having the combination of the two roles has improved the facility understanding of the CSO, and the criticality safety basis behind the applicable limits and controls. It also supports both entities spending more time in their facilities of responsibility. Finally, it provides the CSE and SCSE significantly improved insight into facility operations.

Q4 What training in these areas is provided at your site?

Response 1: The NSC Engineers get trained or are required to read about all of the above.
The Facility Managers get trained and complete oral boards that contain questions on the items above.
The Operations Supervisors complete training and qualification cards that pertain to the items above

Response 2: On the job training (OJT), or NCS Engineer Qualification training is the only training that is used at Isotek to enhance or establish knowledge in the interface function. There is required reading of job procedures, and our procedures do a fair job of documenting the activities that require interfacing, but there is not much that actually has the interface as a focus. OJT is often considered useful, and Isotek has a senior staff that has been at this job for a long time, so most know what is required to ensure adequate implementation of NCS controls.
Response 3: NCS Manager training (also known as supervisory training) handles these duties in general terms, with the exception of the hazard assessment. General assessment training is also provided.

The Portsmouth Site is in D&D mode, although we do have a CSO program in place, the CSO program is not as robust as at some of the other sites within the Complex and the actual CSO duties at this site are limited in scope.

Training for the CSO's at the Portsmouth Site is not well established and consists primarily of three elements:

- Completion of Nuclear Criticality Safety for Managers (Site class)
- Completion of CSO Qualification Card
    - Mentorship of Senior NCS Engineer
    - 6-months in area
    - Participation in 4 NCS walkdowns w/qualified CSO or NCS Engineer
    - Sign-off by NCS Manager
    - Required Read
        - ANSI Standards
        - DOE Orders
        - NCS Documents
- Completion of all Site required classes for D&D workers

The CSO's at the Portsmouth Site are utilized primarily to support Criticality Incredibility through walk-downs, paperwork reviews and documentation.

Response 4:

- Both the CSR's and FMSs get a very high level course on Nuclear Criticality Safety.
- The retired training course for CSR's required them to read the NCSET modules. The core competencies for the CSRs are a subset of those for CSEs. For nuclear physics training and nuclear accident review the expectation is that CSRs are familiar with the information; instead of having a working knowledge or expert knowledge that would be expected of CSEs or senior CSEs.
- A significant portion of the training for CSRs is by reading assignment.
- The training program for CSRs and CSEs is currently under revision.

Response 5:

a. There is no formal training, just on the job training with a mentor.

Response 6: N3B: We are working on establishing training courses for these areas. We will be training personnel (both management and operations), as we prepare to implement the NCS program, on the various NCS program supporting documents. After this training material is developed, it could be provided to others within N3B. Some courses, such as hazard assessment, would be best contracted out.

LANL: LANL has provided training for many of these areas. ABS Consulting did an HA course, and LANL has courses for instructors who provide training. LANL has many training classes that would help, but many of the NCS analysts did not avail themselves of the opportunities to receive additional training.

Response 7: We essentially have 3 required trainings.

The first is a site or job specific training that each facility is responsible for, but that NCS is involved in creating or reviewing, and will either provide the training or attend and answer any questions. These are very worker focused and not really an CSO type thing, although if we had a CSO they would be leading these.

Then there is NCS120, which is required every biennially and is for all workers, supervisors, and other identified staff (managers are encouraged and almost all take this course). NCS120 is geared to what workers require.

Next we have NCS220- (all who take this course also must have NCS120), also required biennially and which is geared towards managers and supervisors. I think our NCS220 as very similar to what a CSO would need but just not as detailed. In NCS220 we cover much the NCS programmatic responsibilities for supervisors/managers (ANSI/ANS-8.19) – each time highlighting various ones, discuss upset conditions and hazard identification and how NCS must partner with operations for determining these, procedures/postings, reviews/assessments, noncompliance response, general interface between NCS and Ops, overall safety culture, questioning attitude, the need for as Roy Reider so effectively put it - "a little bit of King Henry in the night" [i.e., floor presence], accident/near-miss lessons learned (local and external), etc. We try to update and focus on different aspects in NCS220 so that it is always a bit fresh and encourage sharing among the various supervisors/managers.

Response 8: Training addressing this interface is provided for operations under ANSI/ANS 8.20 requirements and for Criticality Safety Engineers and Representatives primarily as part of the qualification processes under ANSI/ANS 8.26.

Response 9:
HS0018-W, General Hazards Training
HS3100, Fundamentals of Criticality Safety
IS1001-W, Principles and Elements of the LLNL Work Planning & Control Process
IS1002-W, The LLNL Work Planning & Control Process
IS0013-W, LLNL Work Planning and Control for AI's, RI's and Other Key Work Control Personnel
RI Guide to Assigning Tasks, Hazards & Training to Workers in eIWS

Response 10: More of the details of the SRS CSO, and CSE, training program are documented in the provided *CS Engineer Training & Qualification Program Description.*

Q5 Does your site have a specific position (full or part time) assigned the duties in the bullet list at the top of this document?

Response 1: One of the NCS Engineers on this project is assigned as the NCS Engineer assigned to support Operations. This person comes to the Plan of the Day, Plan of the Week, maintenance work package planning meetings and engineering modification meetings. The engagement at that level is one of the key's to this project's success.

Response 2: Isotek does not use the Criticality Safety Officer (CSO) concept used by some larger M&O contractors. Instead, NCS Engineers have roles that result in them performing the direct interface with the Operations staff. As noted earlier, two NCS Engineers are assigned the lead role in providing NCS interface in the two nuclear facilities Isotek operates. The duties of the lead facility NCS Engineer are summarized in item 1) b. above. Both positions are full time positions.

Other NCS Engineers, while not acting as facility leads, still receive training and are fully capable of performing any of the interface roles. The relatively small size of the Isotek organization makes it imperative that all NCS Engineers are capable of fulfilling any NCS role.

Response 3: Criticality safety program implementation – This is handled by the operating group with NCS Engineering and CSO assistance. Although there is a specific group of personnel designated to administer the elements addressed within this bullet, and the manager of the group is ultimately responsible for the overall program implementation, there is not a single individual specifically assigned to oversee all these various aspects,

- Assessing process drift – This element is addressed by the staff during the annual assessment process, but there is not a single individual specifically designated to monitor this issue.
- Annual operations review – There are specific staff members who coordinate the Annual Assessment performed by the Operations group, and the Annual NCS Walk-Through program.
- Infraction grading and response – This element is addressed within the process for developing Anomalous Condition Reports (reports addressing off-normal conditions) but there is not a specific staff member assigned to this task.
- Understanding of roles and responsibilities – This element is overseen by the group's manager.
- Coordination of the team hazard assessment part of the evaluation – This effort is managed by the Criticality Safety Engineer assigned to generate the assessment.

Response 4:

- For criticality safety program implementation - the FMSs and CSR's perform this function for at least part of their time.
- Assessing process drift – The FMSs, CRSs, and CSEs perform this duty as a part time activity. Often research program managers will discuss the impact of new research with the CSEs.
- Annual operation reviews – the FMLMs, FMSs, and CSRs perform this function for at least part of their time.
- Infraction grading and response – this is evolving, operations management does this part of their time with support from CSRs and CSEs
- Defining of roles and responsibilities of CSRs is currently in revision.
- Coordination the team hazards assessment – This is often setup by the CSRs and may include a hazards assessment expert to facilitate the assessment.
- Current plans to assign a CSR to one facility in a full time capacity.

Response 5:

a. Y-12 has a Criticality Safety Officer role, but the list of responsibilities are split between the CSO and the NCS engineer.

Response 6: N3B: N3B does not intend to use CSOs, which has been the historical bailiwick for these duties at some sites. Our operations a typically simple and few (waste drum storage and remediation) so it does not appear that even a part time position would be justifiable.

LANL: LANL has CSOs, but it is a collateral duty. The CSSG and others have pressed them to make this a full-time job, and it really should be. CSOs that LANL uses are typically fairly new

employees and do not have a specific set of courses that must be completed. LANL has hired experienced CSOs in the past, but they eventually left.

Response 7: No, we do not have a specific position and I don't see a need as a small site. However, I fully support such a position for most sites.

Response 8: With two full-time Criticality Safety Engineers on staff, both have overall responsibility for all requirements.

Response 9:

- CSP Implementation is an RI + CSE (shared) responsibility. CSEs do the evaluation, RIs implement, both maintain.
- Assessing process drift is an RI + CSE (shared) responsibility formally performed as part of a documented Basic Annual Review (BAR).
- OPS reviews include BARs and quarterly, annual, or ad hoc walkthrough inspections. Operations with significant quantities of fissionable materials are formally identified with (minimum) quarterly walkthroughs with the CSE and RI (or designee – a senior operator).
- Infraction grading and response. Recovery planning is a shared responsibility of the RI, workers, CSE, and Facility Management. The Nuclear Criticality Safety Division issues a formal "Infraction Report". Facility management or other may issue additional reports (e.g., ORPS).
- Roles & Responsibilities are provided at the Institutional Level in R2A2s and ES&H Manual. At the Facility level, they are identified in the DSA and Facility Safety Plan (FSP). At the activity level, they are identified in the Operational Safety Plan (OSP) or Integration Work Sheet (IWS)/Safety Plan (SP), etc.
- Criticality safety evaluations are performed per internal procedure compliant with DOE-STD-3007-2017.

Response 10: The CSO/CSE positions are full time positions. Most facilities have multiple staff members in these roles, while some facilities may share several staff members to provide the needed support.

Additional Notes:

- There are many areas in the interface between operations and NCS personnel that need to be emphasized and improvements made. The hazard analysis is really the most important part of the NCS evaluation. The criticality accidents that have occurred have been due to scenarios that were not identified and analyzed by the NCS evaluation. It is easy and convenient to short change this activity. The NCS analyst can always add conservatism to bound the credible upset conditions, but this can lead to unnecessary conservatism in the analysis and unneeded controls being used. (I presented a paper at the 2016 EFCOG meeting on this.) It seems (based on my time at LANL) that no one seems to have enough time, nor sometimes any interest, in doing this well.

- The annual review of operations needs to be more than just a perfunctory activity. The NCS analyst and operations personnel need to be aware of how necessary it is, not just to meet an ANSI/ANS standard requirement and check a box, but to ensure the ongoing safety of the operation and effective implementation of the controls.

- If the NCS evaluation is written well, it will help in determining how to grade an infraction, and whether the infraction actually impacts the safety margin. There is no substitute for writing the NCS evaluation clearly, and with enough detail, to facilitate this.

- As I mentioned above, spending time with operators and with operations management is absolutely necessary so they understand that you really are there to help them, and they will be less reluctant to call if there is an issue to be dealt with.

- Finally, implementation of the NCS requirements/control suite needs to be emphasized. At LANL, some NCS analysts thought a thorough implementation process was not necessary. At RFETS, we used an implementation matrix that mapped each control into procedures, postings, and configuration management (maybe not into a CM program, but at least noted how the specific, credited attribute was confirmed to be present). The N3B program follows this latter path, requiring a distinct process for implementation apart from the annual review activity.

Attachment 7 – Detailed Responses from Operations/Production Managers

Q1 Please describe how your organization involves productions/operations staff and criticality safety staff in the execution of these duties.

Response 1: Criticality Safety Engineering is responsible for documenting and establishing the INL program and performing criticality safety evaluations. INL line management (usually this person is the Facility Operations Manager) owns the criticality safety of their facility. Facility managers are required to take a face-to-face training course with Todd that discusses criticality safety program requirements and Ops/Crit Safety roles and responsibilities (mainly from 8.19). There is also a facility specific checkout that takes place where we go over the facility engineered/admin controls and implementing procedures. Each course takes about an hour and establishes a relationship and rapport between organizations.

Facility managers don't have the time to focus on criticality safety so the facility manager assigns a Criticality Safety Officer to be the advocate for crit safety in the facility. The CSO acts as liaison between Ops and Crit Safety Engineering. The CSO reviews and concurs on criticality safety evaluations and participates in the scenario development. Concurrence means they agree with the assumptions and that the controls can be implemented. The CSO is responsible for the facility implementing procedures.

After a CSE has been completed, crit safety engineers, together with the CSO, train the operations staff (operators and supervisors) on the new controls - how and why the controls were derived. Ops staff and Crit Safety agree on the wording of controls during the training sessions. The sessions enable Ops to have ownership of the controls and controls that the operations staff understand. We have found that the Operations Staff are much better at crafting the controls than we are. Their involvement in finalizing the wording is important.

Response 2: Validation sessions are an excellent example of operations involvement in the Crit Safety process. Here the hands-on people provide valuable input into the development and refinement of crit safety controls.

Response 3: I am the ORNL Manager for the Mobile Uranium Facility (MUF) This is a joint project with Y-12 and ORNL. Our team is comprised of x – Operations Managers and engineers for the Y-12 Operations facilities and current certified operations Managers and fissile material handlers from the Y-12 Facility. Our team has one Criticality Safety engineer assigned from ORNL and one from Y-12. Our operation is unique because it occurs outside the United States. Our team will be in a position to have to make Criticality Safety decisions on the spot without the benefit of time to consult with ORNL and Y-12 Safety organizations. Please note, we do have two Criticality Safety Engineer on our team at the location to help us make decisions on moving forward when unanticipated problems arise.

Q2 What tools or background knowledge would benefit staff responsible for performing these duties?

Response 1: There is a qualification to be a CSO at INL. The qual basically trains them on the principles of crit safety, the INL criticality safety program, roles and responsibilities, facility specific controls, and crit safety in the DSA. We encourage, but do not require that CSOs attend one of the crit safety short courses. Virtually all of them have been. Many have attended the two-week experimental course at the DAF. Others go to the UNM course. The CSOs are in Operations so there isn't any need to include infraction training as we use the DOE reporting requirements. Operations staff are required to and trained to stop work and notify criticality safety engineering for

concerns and noncompliance. CSOs are usually fissionable material handlers and very knowledgeable of FMH requirements. CSOs normally already get conduct of ops, event reporting, human reliability, working with plutonium, USQ, and safeguards and security training.

Response 2: Criticality Safety staff should be a well-rounded employee with a variety of work experience involving management, oversight and safety. I think having an initial and recurring qualification program (much like the RCT core program) would be beneficial for criticality safety oversight based on ANSI 8 and general industry safety standards focusing on criticality safety basics and covering issues (MNC's, DEF's) that have occurred at Y12 and other facilities since the previous training cycle. Criticality Safety Professionals should have at least a basic knowledge of nuclear, chemical and biological sciences. Have an intermediate to advanced knowledge of computer skills, conduct of ops and causal analysis/incident investigation. Have advanced knowledge on criticality safety with hands on experience, experience in project management or supervision as well as instructor experience would each be beneficial.

Response 3: It would be nice to have the team witness in some manner, the Hands on Management Criticality Safety Training that is available at the NNSS. This does not mean sending the whole team out there. But it does mean that it would be nice to have a video of some of the experiments that show just how sensitive criticality scenarios can be. I say this because I don't believe all the fissile material handlers and supervision believe it at times.

Q3 What specific topics would be helpful for individuals tasked with the interface function?

Response 1: I recently asked some of our CSOs this question. They told me that the existing INL Qual and the criticality training at DAF/UNM is adequate for them.

Response 2: Causal analysis training, incident investigation, safety management, technical writing, project management, critical thinking, change control processes, auditing and communication.
NCSE qual program
CSO qual program
STA qual program

Response 3: Accident history; perhaps listing the magic merv criteria in order of significance. In other words, which magic merv criteria are most likely to cause an accident. I think it would provide a basis for a lot of discussion and understanding the principles involved with preventing a criticality.

Q4 What training in these areas is provided at your site?

Response 1: See discussion above.

Response 2: Most of the recommended training (see above) is either available onsite or accessible at another DOE facility.

Response 3: Basic, programmatic and supervisor criticality Safety Training.

Q5 Does your site have a specific position (full or part time) assigned the duties in the bullet list at the top of this document?

Response 1: Criticality Safety Officer. The position is almost always a collateral duty. Most of the CSOs are also Material Balance Area Custodians for safeguards and security.

The CSO program is a very important element to the overall INL program. We're quite "chummy" with our CSOs and have a great "teaming" environment.

Response 2: I believe engineering, operations, and production are all responsible for the bullet list above

Response 3: Yes

Attachment 8 – Detailed Response from CSCT

Q1 Please describe how your organization involves productions/operations staff and criticality safety staff in the execution of these duties.

- PNNL has one HC-2 facility with a credible risk of criticality. The site office nuclear safety team annually reviews and approves the safety basis, DSA, etc. Criticality Safety Program and SSO are evaluated annually and triennially as prescribed, including facility walkdowns. The PNSO team meets regularly with the contractor Nuclear Operations division and crit safety staff to discuss the state of corrective actions, upcoming facility mods, off-normal events, etc. A DOE fac rep is dedicated to the facility and conducts regular inspections, which sometimes include other site office staff, such as myself.

Q2 What tools or background knowledge would benefit staff responsible for performing these duties?

- The most useful right now would be having a staff member who is fully qualified in criticality safety. I am currently working on the TQP, but in the meantime PNSO/PNNL requires support from the ISC—currently Kermit Bunde. The practical aspects of performing walkdowns would be particularly helpful as well.

Q3 What specific topics would be helpful for individuals tasked with the interface function?

- Training/workforce development, including curriculum.

Q4 What training in these areas is provided at your site?

- PSNO, the PNNL site office, is too small to have much local training. In conjunction with the Richland Operations Office and the Office of River Protection, training courses in the above areas are sometimes brought to the region (HAMMER training complex, Richland WA). These courses are ad-hoc however, and not provided on any regular schedule. Most of our training is delivered through the Nevada Field Office and National Training Center near Albuquerque/Los Alamos.

Q5 Does your site have a specific position (full or part time) assigned the duties in the bullet list at the top of this document?

- I am assigned criticality safety duties at 0.3 FTE, with an additional 0.1 FTE of my time dedicated to other tasks as part of the Nuclear Safety Team. The Nuclear Safety Team consists of three staff members, but I am the only one focusing on criticality. There is also one full-time facility representative dedicated to PNNL's HC-2 facility.