April 20, 2022

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

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

DAVID HAYES (Affiliate)
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Date: 2022.04.21 11:59:14 -06'00'

Subject: CSSG Tasking 2022-01 Response

The CSSG has completed its action on Tasking 2022-01. The attached report is submitted for your review and approval.

Contract transitions have resulted in myriad issues disrupting Criticality Safety Programs. To help DOE oversight ensure successful contract transition from the perspective of criticality safety, the CSSG was directed to develop recommendations for consideration during each phase of a contract transition. While contract transitions are severe disruptors, the CSSG herein also provides recommendations to help minimize disruptions related to changes in organization, funding, and/or mission.

The CSSG subgroup was comprised of the following members:

Fitz Trumble (Team Leader)
David Hayes (LANL)
David Heinrichs (LLNL)
Kevin Reynolds (Y-12)

The attached response was developed by the subgroup, reviewed by the entire CSSG and all comments were addressed and incorporated.

cc:
CSSG Members
D. G. Bowen
M. Henley

Attachment: Response to CSSG Tasking 2022-01

Response to CSSG Tasking 2022-01

CSSG Guidance on Contract Transition with Regards to Nuclear Criticality Safety

April 15, 2022

EXECUTIVE SUMMARY

In general, the Department of Energy [DOE] (including the National Nuclear Security Agency [NNSA]), Environmental Management [EM] as well as the Office of Science [SC] and Office of Nuclear Energy [NE]) and their contractors experience significant change during contract transitions for Management and Operating (M&O), Management and Integration (M&I) and Indefinite Delivery Indefinite Quantity (IDIQ) contracts for Federal Sites operated by contractors for the DOE. During past contract transitions issues have arisen that have caused notable disruptions, loss of competence, and impaired mission achievement associated with the impact of these transitions on the site's ability to perform to an expected level of nuclear criticality safety (NCS).

While contract transitions are the most severe driver of these disruptions, significant changes to a contractor's organization, funding or mission have also caused disruptions in the past. In CSSG Tasking 2022-01, the CSSG is tasked with providing guidance to DOE (NNSA, EM, OS, NE) in their role of performing NCS oversight functions on ways to minimize these disruptions in the future.

This Tasking Response has been prepared by the CSSG in response to CSSG Tasking 2022-01 (included as Attachment A). The tasking directs the CSSG to consider the following topics:

- Criticality safety practices in support of mission success.
    a. Proper use of conservatism/assumptions/process knowledge during Criticality Safety Evaluation Process
    b. Continuing criticality safety integration with Safety Basis and Operations.
    c. Development of relationships between the new contractor and the local field office.
    d. Potential unintended consequences of the contract language/incentives/timing on NCS.
- Criticality Safety post transition and due diligence.
    a. Ability to understand and alleviate past criticality safety issues from the outgoing contractor (tribal knowledge).
    b. NCS organizational structure and position in the organization.
    c. NCS staffing ability/retention of the new contractor coming into the contract.
    d. Knowledge transfer and collective knowledge retention among NCS practitioners.
    e. Criticality Safety Training and Qualification post transition.

f. Maintenance of the criticality safety program at a level beyond "minimum mission essential".

- Informed decision making on the continuation/support for Criticality Safety Committees.

In addition, the CSSG may provide any guiding thoughts to be considered for incorporation by DOE into future contract requirements.

Based on the examples provided in this tasking response, the CSSG provides the guidance/recommendations shown in Table ES.1 for consideration by DOE in the periods leading up to, during, and after contract transition. Many of these recommendations can also be used by DOE to monitor contractor performance during periods of perturbations due to contractor changes in organization, funding, or mission.

Table ES.1 – Guidance and Recommendations to DOE for Effective Oversight of Criticality Safety in Contract Transition

Timeframe	**Guidance/Recommendation**	**References**
Request for Proposal (RFP)	If there are/will be multiple regulatory owners at a single site, these DOE organizations should coordinate during RFP development and evaluation to ensure that missions of all organizations can be maintained both during and after the contract transition. Where possible, avoid RFPs which 'split' existing NCS scope into multiple contracts/contractors: To the extent practical, the NCS function should be performed by a single group operating to a single program to ensure consistency. One exception is if the missions are so dissimilar that having different programs to tailor NCS to the operational needs makes sense. Where split contracts cannot be avoided, award those contracts simultaneously to prevent significant staffing shifts between contractors. Prime contract durations and their attendant impacts should be carefully considered as part of the contract planning process. Short duration (less than 5 years) contracts should be avoided as it does not incentivize a contractor to invest in the program or allow time for improved performance or staff development.	Tasking 2020-01, What's Wrong with Criticality Safety Programs? 2020 version

	In the RFP, require the contractor to submit a written plan on how to manage the NCS program specifying the organization, its mission and vision, its customers and scope of services, its required competencies, staffing and financial resources, reporting chain, and funding model. DOE, during RFP planning and evaluation, should specifically evaluate the ability of the contractors to attract, retain, and maintain adequately trained and qualified staff. Ensure continuous improvement in NCS is directly called out and scored as part of any new contract to ensure proper focus on existing and necessary initiatives. Request CSSG review of Field Office NCS staffing levels with recommendations, as needed, for augmented staff during RFP review, interviews, selection, and transition.	
Interview and selection of a new site contractor	Ensure the bidding site contractor addresses metrics including those specified in the annual DOE report to DNFSB on contractor criticality safety programs and has identified key resources essential to address identified issues, improve processes, and maintain or build a strong CSP. Ensure retention of qualified NCS staff is recognized as a high priority need and ensure that training, pay, and critical skills retention programs are appropriately set up to mitigate the effects from any attrition that does occur. Ensure high level company (enterprise) leadership for the NCS functions (both the day-to-day engineering function and the broader continuous improvement function.) Upper management in the reporting chain of the NCS group should have operational awareness of or experience with the NCS function.	Tasking 2020-01, What's Wrong with Criticality Safety Programs? 2020 version

Site contract transition	Integration or separation of criticality safety staff by contract and the attendant impacts on staffing, process knowledge, procedures, programs and records should be evaluated to determine ways to minimize mission impacts. Impacts on the NCS organization, its infrastructure, access to information, staffing, and programs should all be evaluated as part of the contract transition. Ensure criticality safety is a safety discipline and organization separate from health physics and safety basis and reports to a top-level site contractor manager. Identify key resources including a budget and staffing plan including hiring, retention, and succession planning. Ensure the contractor submits a revised Criticality Safety Program Description Document as required by DOE O 420.1C. Ensure that during transition, issues management systems are not purged or replaced without a full understanding and documentation of the issues and their current status. Open issues should be identified by the new contractor along with commitments to continue resolution of current issues. Ensure the contractor retains or establishes a Nuclear Criticality Safety Committee (NCSC) as another means of ensuring engagement with senior managers. Note CSSG Response to Tasking 2009-1 provides guidance on the purpose, structure, and operations of criticality safety committees.	Tasking 2020-01, What's Wrong with Criticality Safety Programs? 2020 version Tasking 2009-01
Contractor operations	Ensure criticality safety is formally identified as a functional area with its own performance metrics so that the contractor and field office can effectively assess the integrated health of the criticality safety program. Ensure that the impacts of staff loss due to change of benefits and reorganization do not adversely	Tasking 2020-01, What's Wrong with Criticality Safety Programs? 2020 version

	impact the criticality safety organization. Consider specific actions to retain key personnel (e.g., who retire due to change of benefits) as contractors to ensure a smooth transition. Ensure a healthy NCSC that is actively engaged by senior management. Ensure that contractors are not driven to a "mission safe essential" program mentality where continuous improvement is sacrificed for cost savings. If split contracts are put in place, ensure contractors are incentivized to also promote overall site mission accomplishment (e.g., planning for and availability of service level agreements between contractors should be evaluated if multiple contractors are on the site.) Ensure that mission changes to be implemented in the future are not allowed to degrade the expectation for "excellent operation" at the current time. Ensure new contractors with new missions understand which limits and controls remain relevant to the operations being performed.	

INTRODUCTION

Background

The Department of Energy issues Request for Proposals (RFPs) associated with managing the Federal nuclear sites and their respective missions (e.g., production, research, D&D). Source selection committees of Federal employees are assigned to evaluate the proposals that are submitted by contractor organizations leading to a decision and award of contract to operate the Site, on behalf of the DOE, for a given period of time (typically from 3-10 years) with the potential for extensions depending upon performance. It is a DOE expectation that this contractor organization will provide the DOE with operating expertise and staff (operational support) sufficient to ensure that the mission of the Site is accomplished in an efficient and effective manner. Thus, any disruption that reduces the efficiency or effectiveness of a contractor's implementation of the contract deserves to be evaluated to determine how best to avoid this situation.

There are many facets of this operational support that are interconnected which must all function at a high level in order to attain maximum efficiency and effectiveness in achieving the mission. While Criticality Safety is but one of these facets, history shows us that issues in this area, which may be seen across a number of operational functions, can have severe impact on the ability of the site to accomplish its mission.

Past experiences with regard to nuclear criticality safety (NCS) will be provided here as well as summarized into guidance that DOE can use to evaluate the likelihood of issues developing that may impact NCS in the period leading up to, during and subsequent to a contract transition. As noted in earlier DOE activities (see Criticality Safety Self-Assessment Workshop available on the NCSP website) which pre-dated the Toki-Mura criticality accident in Japan, and the NNSA Technical Bulletin article on risks to NCS programs (Appendix B) significant mission impact and delays have been experienced by the DOE when these disruptions are not avoided.

The CSSG was tasked in CSSG 2022-01 to generate a list of these disruptions, their causes, and potential ways to avoid or mitigate them. This report is the response to that tasking. The report provides examples from past transitions (at multiple Sites) and significant changes impacting NCS (organizational, funding, mission) to provide the context of the disruption, potential ways that this could have been avoided, and where appropriate, thoughts on how to construct/manage events which led to these issues in a way that would avoid or mitigate them. The examples provided are organized to be roughly chronological.

Examples

A. Contract change creating INL and ICP (2005)
B. Mission and contractor changes at Livermore (2007)
C. Contract change at Savannah River (2008)

D. Contract/mission change at Paducah (2011/2013)
E. Organizational change at LANL (2012)
F. Contract change combining Y-12 & Pantex (2014)

Discussion

A. Contract change creating INL and ICP

Background

In 2005 the INEEL contract regulated by DOE-EM was split into an NE operations contract for the lab/reactors and an EM regulated cleanup contract supporting D&D and waste. The lab/reactors contract also incorporated what used to be Argonne West, managed by Argonne National Laboratory under SC regulation. DOE-EM went from a lead organization at the site to a tenant regulator on a NE managed/regulated site.

Issue

The Idaho National Laboratory/reactor (INL) contract which was for a longer duration than the expected D&D/waste contract (Idaho Cleanup Project), was awarded first by about a year, and subsequently that contractor offered positions to approximately 80% of the original combined staff. The mission staffing would have necessitated that the ICP contractor would need about 30-40% of the original staffing. Once the INL contract was awarded, the ICP and subsequent contractor found themselves severely understaffed, in an area where it is difficult to attract staff. This condition persisted for about a year until the ICP could hire additional resources. The splitting of the group also caused a break in the level of interaction between members of the original group leading to inefficiencies and knowledge loss. Many of the more senior NCS engineers went with the NE contract, thus depleting both plant process and NCS knowledge. Both NCS engineers that went to the ICP eventually left the ICP.

Service level agreements were put in place to provide support from the INL contractor to the ICP contractor for access to intellectual property (validated NCS computing infrastructure, classified computing, and records management (for NCSEs)) as well as part-time access to some of the engineers who had been supporting those facilities now under the ICP. The INL however was very busy during this time as much of the safety documentation for the Argonne West facilities was determined to be non-compliant, thus creating a large bow wave of work for both NCS and safety basis staff at the INL and leaving little time to respond to ICP requests.

Based on differences in the missions (NE vs EM) differences in the Criticality Safety Programs developed and eventually two separate programs were put in place. While this represented an increase in workload to maintain two programs, efficiencies were gained by the additional flexibility written into the EM program to allow for one-time events and limited life facilities as they were being cleaned out and decommissioned.

Recommendations:

- During times of significant mission change for a site, DOE should carefully evaluate the scope of the mission change, any changes in regulatory approach (i.e., NNSA to EM, SC to NE, etc.), and if the contract is to be split or combined. Impacts of these changes on the criticality safety organization, its infrastructure, access to information, staffing, and criticality safety programs should all be evaluated as part of the contractor's transition.
- If there will be multiple regulatory owners at a single site, these DOE organizations should coordinate during RFP development and evaluation to ensure that the missions of all organizations can be maintained both during and after the contract transition.
- The planning for and availability of service level agreements between contractors should be evaluated if multiple contractors are on the site.
- Integration of, or separation of, criticality safety groups, and the attendant impacts on staffing, process knowledge, procedures, programs, and records should be evaluated to determine ways to minimize mission impacts.

B. Mission and Contractor Changes at Lawrence Livermore National Laboratory (LLNL)

Background

Throughout the era of nuclear testing, the LLNL Weapons Program, Test Program and Laser Program provided all funding for criticality safety at LLNL. However, this changed when President George H. W. Bush declared a unilateral test moratorium on October 2, 1992. In this same timeframe, the LLNL contractor, the University of California, offered three Voluntary Early Retirement Incentive Programs (VERIPs) throughout 1990-1993 and by 1993, all but two criticality safety engineers (CSEs) had retired. Of these two, one left for a management position in another laboratory organization, and criticality safety ceased to exist as a separate organization. The CSEs were then combined into the health physics discipline with severe consequences due to the lack of management understanding of the criticality safety discipline and its regulatory drivers.

Shortly thereafter, the one remaining CSE, and a former diagnostic physicist from the defunct Nuclear Test Program, were assigned to two of six multidisciplinary integrated ES&H teams: Team 1 primarily supporting the Superblock; and Team 3 primarily supporting the Defense Technologies Engineering Division (DTED), a merger of the Weapons Engineering Division and the now defunct Nuclear Explosives Engineering Division. At this same time, Federal expectations and oversight increased in response to issuance of DOE O 5480.24 and its successor document, DOE O 420.1.

Issue

These changes created a perfect storm culminating in repeated violations of criticality safety controls in handling fissionable materials. A subsequent for-cause audit by the DOE Oakland Office (OAK) resulted in the shutdown of the Plutonium Facility for 18 months. Re-start

involved a re-assessment of the causes of failure by LLNL senior management, DOE*, and DNFSB, which included:

- Management inattention
- Loss of criticality safety as a safety discipline organization
- Insufficient staffing
- Inadequate resources
- Lack of independence from operations
- Marginal oversight

In response, LLNL developed and implemented the following corrective actions to enhance the Criticality Safety Program†:

- Recognizing criticality safety as a discipline requiring focused, standards-based management
- Re-establishing the criticality safety group as its own organization in the Hazard Control Department reporting directly to a top-level senior contractor manager
- Performing a nation-wide search for a seasoned manager to lead the organization
- Establishing funding for "a strong core criticality safety program"
- Establishing field staff supporting floor operations and resident in key facilities but accountable to criticality safety management
- Simplification and standardization of criticality safety controls
- Criticality safety academic training per ANSI/ANS-8.20 tailored for specific groups and needs
- Hands-on training which includes measurement of reactivity changes when criticality safety parameters are changed
- Enhanced emergency response training per ANSI/ANS-8.23

The next challenge to the Criticality Safety Program occurred with transition of the management contract from the University of California (UC) to the Lawrence Livermore National Security (LLNS), LLC, on October 1, 2007. Transition resulted in a significant change to employee benefits resulting in the retirement under UC of senior staff including the Criticality Safety Section Leader. Fortunately, the LLNS contract established Nuclear Operations as a new directorate and key management position focused on 10 CFR 830, *Nuclear Safety*, which included DOE O 420.1C as the Federal expectation for criticality safety. As part of transition, LLNS:

- Established and elevated criticality safety as a division separate from Safety Basis reporting directly to the Associate Director for Nuclear Operations. [Note that in May 2020, LLNL eliminated Nuclear Operations, and the Nuclear Criticality Safety

* *Assessment of the Criticality Safety Program at Lawrence Livermore National Laboratory, April 23 – May 3, 1996*, Mark Lee, DOE/OAK, May 23, 1996.
† J. S. Pearson et al., *Recent Changes to the Criticality Safety Programs at LLNL*, UCRL-JC-143200, August 22, 2001.

Division has returned to the ES&H organization with three re-organizations since then. This is a matter of concern to the institutional Criticality Safety Advisory Committee.]

- Established a Standards Based Management System (SBMS) identifying orders and standards pertinent to criticality safety
- Developed a Criticality Safety Program Description Document as required by DOE O 420.1
- Identified internal and external customers defining the full scope of criticality safety demands
- Established hiring programs for summer students, post-college graduates and postdocs for talent spotting
- Supported R&D activities in support of the DOE Nuclear Criticality Safety Program (NCSP) to maintain a larger cadre of criticality safety engineers to meet surge demands and ensure stability

Recommendations:

- DOE, during RFP planning and evaluation, should specifically evaluate the ability of the contractors to attract, retain, and maintain adequately trained and qualified NCS staff.
- Ensure continuous improvement in NCS is directly called out and scored as part of any new contract to ensure proper focus on necessary initiatives.
- Ensure high level company (enterprise) leadership for the NCS function (both the day-to-day engineering function and the broader continuous improvement function)
- Ensure criticality safety is a safety discipline and organization separate from health physics and safety basis and reports to a top-level site contractor manager.
- Identify key resources including a budget and staffing plan including hiring, retention, and succession planning.
- Ensure the contractor submits a revised Criticality Safety Program Description Document as required by DOE O 420.1C.
- Ensure that the impacts of staff loss due to change of benefits and reorganization do not adversely impact the criticality safety organization. Consider retention of key personnel (e.g., who retire due to change of benefits) as contractors to ensure a smooth transition.

C. <u>Contract change at Savannah River</u>

Background

In 2008 the Savannah River Site contract, which had been a single M&O contract with the same contractor for 11 years, was split into two mission-based contracts; One to manage the liquid waste portion and the Defense Waste Processing Plant, and the other an M&O to manage the remainder of the Site including the Savannah River National Laboratory. The timing of the contracts were such that the M&O was awarded first followed about a year later with the award of the liquid waste contract. The criticality safety organization, which was fully comprised of staff from a subsidiary of the original M&O contractor, was then faced

with a choice to remain with their current employer (which supported multiple DOE Sites) and change facilities they supported or move to the new M&O contractor to maintain support of their current facilities.

Issue

The winning M&O contractor did not have sufficient criticality safety staff lined up at contract transition to perform the mission. The plan was to "pick up" the original M&O contractor's affiliate staff that were performing the non-liquid waste functions and "roll" them onto their employment roles. This is a typical practice for new contractors replacing incumbents – however the dynamics of the relationship of the employees to their parent company was not fully appreciated, and a fair number of the staff chose to remain with the original M&O affiliate. This led to a severe staff shortage of NCS staff for the new M&O contractor and reduced ability to achieve mission the first year of the contract. To compensate for the shortage, the new contractor had to provide signing bonuses and stay incentives over the next 5 years to get sufficient employees to transfer to the new contractor. The effect of this was to significantly raise the cost of labor to DOE for the same service, as well as the reduction in capabilities due to the missing staff (this lasted approximately a year). Subcontracts from the new M&O to the old M&O affiliate were also eventually put in place to obtain access to both staff and specific knowledge. The combination of these actions, plus aggressive hiring of new employees, alleviated the issue and allowed for return to full mission accomplishment within a few years of contract transition. Due to the group being split into multiple contractors, interaction between members of the original NCS group was hindered and inefficiencies and knowledge loss occurred.

*Recommendation*s:

- DOE, during RFP planning and evaluation, should specifically evaluate the ability of the contractors to obtain/maintain adequately trained and qualified staff. This needs to go beyond just their "paper" plan. Part of that evaluation should be the particular relationships between the contractors and their employees (FTEs, subcontractors, affiliates) and as necessary require letters of commitment for those individuals whose loss would significantly impact the contractor's ability to maintain the level of service and mission accomplishment.
- Timing of contract awards should also be carefully looked at when splitting a contract into parts. If the contracts which split a site can be awarded at or near the same time, it may prevent the significant poaching of employees by one contractor or the other.

D. Contract/Mission change at Paducah

Background

In July 1993, the operations of the Portsmouth and Paducah enrichment facilities was awarded to the United States Enrichment Corporation (USEC) under USNRC oversight. In 2011, USEC returned the gaseous diffusion facilities to DOE. Since then, many contracts have been

issued for a variety of services at these sites. Major contracts included services for depleted uranium conversion, gaseous centrifuge operations, decontamination and decommissioning cleanup activities, and site office technical support. In 2013 the M&O contract for Paducah was transitioned from NRC purview back to DOE-EM in preparation for eventual D&D activities. This initial contract was for "surveillance" of the sites, and as such was of limited duration (3 years) and limited funding. It was bid as a small business set aside.

Issue

Due to the small size of the contractor awarded this contract, NCS resources to draw on in support of the contract was quite limited. The short duration of the contract made finding NCS resources (both staff and leadership) to commit to the project even more challenging and hampered efforts to train new NCS staff since they would only just be getting qualified with facility experience at the conclusion of the contract period. Since the short contract duration did not support significant investment in the NCS program by the new contractor, the program limped along with limited support both at the contractor and DOE oversight level until new, longer-duration contracts were put in place.

Early in the transition to the new D&D contractor an assumption was made that the NCS controls were for an operating plant and they failed to follow significant NCS control limits. This led to further issues later in the D&D process.

Recommendations:

- Contract durations and their attendant impacts should be carefully considered as part of the contract planning process. Short duration (less than 5 years) contracts should be avoided as it does not incentivize a contractor to invest in the NCS program or allow time for improved performance or staff development.
- The ability of a contractor to attract and retain resources (especially NCS resources) should be considered carefully as part of the contract award process.
- Ensure the new contractor with a new mission understands which NCS controls remain relevant to the operations being performed.

E. Organizational change at Los Alamos National Laboratory (LANL)

Background

LANL and the NCS program have undergone a number of contract and organizational transitions since 2006. The first contract transition from the University of California (UC) to Los Alamos National Security L.L.C. (LANS) occurred in 2006. In 2018, a portion of waste operations was moved from NNSA to DOE-EM and contracted to Newport News Nuclear BWXT (N3B). The last contract transition from LANS to Triad National Security L.L.C. (Triad) occurred in 2018.

The CSSG has documented LANL NCS organizational impacts in Tasking 2011-06, *Focused Criticality Safety Review at LANL Plutonium Facility (PF-4),* Tasking 2013-02, *CSSG*

Assessment of Scope of Operations and Criticality Safety Staff Capacity and Review of Los Alamos National Laboratory CAP and Metrics for the Nuclear Criticality Safety Program, and Tasking 2017-04, *CSSG review of the LANL CSP*.

Issue

Prior to 2006 (contract transition from UC to LANS) the criticality safety group resided in the health and safety organization of the LANL management structure. Under LANS the NCS group moved to the Nuclear and High Hazard Operations organization. Over the course of the next six years, NCS expectations changed from "expert based" to "compliance based" and the group's interactions with the operating groups began to change. Over this time period the NCS group began to erode with the eventual departure of the entire, experienced staff in 2012. The CSSG presaged such in Tasking 2011-06. Informal exit interviews indicated that management above the NCS group did not understand NCS, neither technically nor operationally. In particular, the importance of an experienced, cohesive, functioning group was not appreciated and supported. In addition, to the demise of the NCS group, the LANL Nuclear Criticality Safety Committee (NCSC) was dissolved. Senior management was of the opinion that NCS engineers were simply plug and play nuclear engineers.

Beginning in 2013 the lack of experienced/qualified criticality safety staff and failures in the con-ops programs led to a Sitewide pause in fissile material operations. Over the next 3-5 years, the NCS group was re-established with new training/qualification programs and heavy reliance on contractor support (which was qualified, but not fully familiar with the processes). This lack of "history" behind why many of the limits and evaluations were written the way they were, coupled with some computational errors found in some of the evaluations, led to a period of increased conservatism in the evaluation of limits and additional restrictions on operations of the processes leading to resumption.

Ultimately, the NCS group was elevated to division status and after rotation through several group leaders with little to no NCS experience, a division leader was hired with some NCS experience. However, as noted in CSSG Tasking 2017-04, the division leader was inexperienced as a manager. In 2018, the division leader departed and was replaced by a division leader with management experience but no technical criticality safety experience. During this period, signing and retention salary programs were put in place to help stem the attrition. However, with the significant reduction in facility-knowledgeable NCS engineers to act as mentors, many of the initial tranche of new NCS staff brought on left the lab as soon as they were qualified. The NCSC was re-established and began again to monitor and provide guidance to senior site leadership associated with the health of the NCS program.

Two transitions occurred in 2018, one transitioned waste operations to N3B with a commensurate standing up of a new NCS group followed by the LANS transition to Triad. Naturally, N3B enticed several LANL NCS analysts to leave, exacerbating an already fragile situation.

NCS was reorganized under ALD-ESHQSS (health and safety). In 2019, NCS moved from ALD-ESHQSS to ALD-FO (facility operations under the director for nuclear safety),

organizationally similar to the change made during the LANS transition. The change was made without consultation with the NCSC who subsequently reminded Triad of the results under the LANS organization.

Currently, ALD-PI (plutonium infrastructure) is attempting to establish a criticality safety group to support capital projects necessary to meet increased pit production requirements. While this group resides within the NCS Division, its creation has resulted in the introduction of new job classes and paybands not currently used in the balance of the division.

As a result of these myriad management, organizational, and contract transitions, turnover amongst NCS staff has been high (~ten-fold that prior to 2006). While functional, the NCS program experiences regular staff turnover and now ten years past the initial exodus still relies on contractor support/expertise. At the end of the fourth quarter of FY21, contractors comprised 6.5FTE out of 25.5FTE or 25% of the qualified analysts. Turnover and growth in numbers of the NCS staff has impacted operations in continuity of communications and consistent application of criticality safety philosophy.

Recommendations:

- Upper management in the reporting chain of the NCS group should have operational awareness of or experience with the NCS function.
- The NCS group should be aligned outside of an operations focused management chain and report at the same level as radiological controls, industrial hygiene level, safety basis, etc.
- To the extent practical, the NCS function should be performed by a single group operating to a single NCS program to ensure consistency.
- Retention of sufficient NCS and production staff to maintain facility familiarity and "tribal knowledge" of the basis behind limits and evaluations must be constantly evaluated during transitions and organizational changes.
- Ensure a healthy NCSC that is actively engaged by senior management.

F. <u>Contract change combining Y-12 and Pantex</u>

Background:

In 2010, the NNSA established a management strategy where the Y-12 and Pantex complexes would be operated under one contract to provide more efficient management and projected large cost savings. The pending contract included significant cost savings targets which were to be achieved by combining operations of the two sites as a single nuclear security enterprise mission. The focus of the pending M&O contract on cost savings had immediate impact upon issuance of the Request for Proposal in 2011. The incumbent M&O contractor instituted budgetary restrictions and reductions to maintain a history of cost control through the proposal evaluation period. It is noted that certain NCS improvement initiatives were being funded during this time because of past oversight findings.

In 2012, the NNSA Production Office (NPO) was established to bring the management of Y-12 and Pantex under one NNSA project office. The initial award date was January 2013, but initial issuance of the contract award was met by protests from the losing bidders. The time frame to resolve the challenges was extensive, bridging two budget years with completion of contract transition on July 1, 2014. During the contract protest evaluation period, the DNFSB issued a letter in 2013 to NNSA identifying thirteen areas requiring enhanced oversite during transition. None of these areas were directed to nuclear criticality safety even though the program was rated as "yellow" and had several improvement efforts in progress. There were areas in the letter that affected NCS such as aging infrastructure, safety culture, conduct of operations, and the contractor assurance system.

Concurrently, the Uranium Processing Facility project was in the design phase under the management and technical direction of a bidder competing with the incumbent M&O contactor.

Resolution of the challenges resulted in contact award to a bidder that was not the primary incumbent, though they were on the M&O management team. However, the winning bidder's past responsibility did not include direct management in the NCS organization, and the transition team did not have any NCS expertise on the team. Many of the incoming engineering managers had no DOE facility experience.

Issue

The new M&O contract was focused on production operations and achieving significant cost savings. This was driven through contract evaluation activities, production evaluation activities and the award fee process. Early cost savings actions focused on staffing "needs". This, along with combining two separate production agencies and the effort to "harmonize" both operating practices and benefits had the net effect of driving management focus away from safety program continuous improvement activities. Early transition strategy called for NCS engineers to be part of production teams and accordingly report to those teams organizationally. Budget for additional staffing to perform improvement initiatives was not included because budgeting was based on ongoing program and project needs and the Y-12 Nuclear Criticality Safety (NCS) Program was perceived as a support function to production operations rather than a core mission enablement program requiring continuous improvement. This shift also resulted in contractor and federal entities focusing resources on production improvements over time and not focusing resources on safety programs and continuous improvement.

During this same time period efforts were underway to support an initiative to replace many ongoing production operations taking place in "late in life" facilities with operations to begin in a new Uranium Processing Facility (UPF). UPF and Y-12 were separated organizationally on both the contractor side and the NNSA side resulting in two NCS organizations reporting to two separate engineering directors. Staffing for the UPF NCS organization was from subcontractors because the design and construction portion of the project was considered of being limited life and that eventually the UPF NCS "design" staff would not be needed.

UPF management attention was focused on properly scoping, designing, and subsequently building the new facility and parts of the Y-12 operation were operated with a mindset of "run to failure". Delays in UPF startup and continuing scope changes, led to some of the ongoing activities in the older facilities needing to continue for the foreseeable future. This caused delays as some of those operations/facilities needed refurbishment and catch-up of deferred maintenance, leading to criticality safety challenges.

Combining the Pantex and Y-12 operations also presented new challenges for NCS because the programs at the two facilities were vastly different due to the nature of the hazards. This created a new, major endeavor to combine organizations that was not anticipated as part of the improvement efforts that needed to continue, thereby requiring redirection of resources from one effort to another.

Further, the significant human resources benefits changes that came along with the new M&O contract accelerated an already existing staff attrition problem in both production and NCS staff resulting in the NCS Program not being able to maintain a core staff of experienced and qualified NCS personnel dedicated to supporting production operations at the two sites. Loss of both NCS and production staff led to a reduction in available process knowledge, eventual process drift, and subsequent fissile material accumulation events leading to production pauses at the site. Some of these events were repeats of similar events which had occurred in the past but for which effective corrective actions had either not been fully implemented or had been removed as the "reason" for them being there had been lost. While not part of the NCS organization, the nuclear safety organization at Pantex suffered greater than 50% attrition after contract change leaving the site with only a few senior experienced personnel. This consumed much management attention that otherwise might have been directed to NCS needs at Y-12.

Recommendations:

- Ensure high level company (enterprise) leadership for the NCS function (both the day-to-day engineering function and the broader continuous improvement function)
- Ensure continuous improvement in NCS is directly called out and scored as part of any new contract to ensure proper focus on necessary initiatives.
- Ensure retention of qualified NCS staff is recognized as a high priority need and ensure that training, pay, and critical skills retention programs are appropriately set up to mitigate any attrition that does occur.
- Ensure that cost savings targets are not allowed to degrade core mission enablement functions (like NCS, system engineering, maintenance).
- Ensure that mission changes to be implemented in the future are not allowed to degrade the expectation for "excellent operation" at the current time.

CONCLUSIONS AND RECOMMENDATIONS

As have been highlighted in these examples, transitions of contracts, missions, regulators, and organizations can (and have) resulted in negative impacts to criticality safety with

concomitant mission impact. Careful consideration throughout the entire planning, selection, transition, and operational process is necessary to avoid or mitigate unintended negative consequences to the criticality safety program. Based on these experiences, the guidance/recommendations in Table 1 are provided to assist the DOE in maintaining the health of the NCS program during contract or organizational transitions.

Table 1 – Guidance and Recommendations to DOE for Effective Oversight of Criticality Safety in Contract Transition

Timeframe	Guidance/Recommendation	References
Request for Proposal (RFP)	If there are/will be multiple regulatory owners at a single site, these DOE organizations should coordinate during RFP development and evaluation to ensure that missions of all organizations can be maintained both during and after the contract transition. Where possible, avoid RFPs which 'split' existing NCS scope into multiple contracts/contractors: To the extent practical, the NCS function should be performed by a single group operating to a single program to ensure consistency. One exception is if the missions are so dissimilar that having different programs to tailor NCS to the operational needs makes sense. Where split contracts cannot be avoided, award those contracts simultaneously to prevent significant staffing shifts between contractors. Prime contract durations and their attendant impacts should be carefully considered as part of the contract planning process. Short duration (less than 5 years) contracts should be avoided as it does not incentivize a contractor to invest in the program or allow time for improved performance or staff development. In the RFP, require the contractor to submit a written plan on how to manage the NCS program specifying the organization, its mission and vision, its customers and scope of services, its required competencies, staffing and financial resources, reporting chain, and funding model. DOE, during RFP planning and evaluation, should specifically evaluate the ability of the contractors to attract, retain, and maintain adequately trained and qualified staff. Ensure continuous improvement in NCS is directly called out and scored as part of any new contract to ensure proper focus on existing and necessary initiatives.	Tasking 2020-01, What's Wrong with Criticality Safety Programs? 2020 version

	Request CSSG review of Field Office NCS staffing levels with recommendations, as needed, for augmented staff during RFP review, interviews, selection, and transition.	
Interview and selection of a new site contractor	Ensure the bidding site contractor addresses metrics including those specified in the annual DOE report to DNFSB on contractor criticality safety programs and has identified key resources essential to address identified issues, improve processes, and maintain or build a strong CSP. Ensure retention of qualified NCS staff is recognized as a high priority need and ensure that training, pay, and critical skills retention programs are appropriately set up to mitigate the effects from any attrition that does occur. Ensure high level company (enterprise) leadership for the NCS functions (both the day-to-day engineering function and the broader continuous improvement function) Upper management in the reporting chain of the NCS group should have operational awareness of or experience with the NCS function.	Tasking 2020-01, What's Wrong with Criticality Safety Programs? 2020 version
Site contract transition	Integration or separation of criticality safety staff by contract and the attendant impacts on staffing, process knowledge, procedures, programs and records should be evaluated to determine ways to minimize mission impacts. Impacts on the NCS organization, its infrastructure, access to information, staffing, and programs should all be evaluated as part of the contract transition. Ensure criticality safety is a safety discipline and organization separate from health physics and safety basis and reports to a top-level site contractor manager. Identify key resources including a budget and staffing plan including hiring, retention, and succession planning.	Tasking 2020-01, What's Wrong with Criticality Safety Programs? 2020 version Tasking 2009-01

	Ensure the contractor submits a revised Criticality Safety Program Description Document as required by DOE O 420.1C. Ensure that during transition, issues management systems are not purged or replaced without a full understanding and documentation of the issues and their current status. Open issues should be identified by the new contractor along with commitments to continue resolution of current issues. Ensure the contractor retains or establishes a Nuclear Criticality Safety Committee (NCSC) as another means of ensuring engagement with senior managers. Note CSSG Response to Tasking 2009-01 provides guidance on the purpose, structure, and operations of criticality safety committees.	
Contractor operations	Ensure criticality safety is formally identified as a functional area with its own performance metrics so that the contractor and field office can effectively assess the integrated health of the criticality safety program. Ensure that the impacts of staff loss due to change of benefits and reorganization do not adversely impact the criticality safety organization. Consider specific actions to retain key personnel (e.g., who retire due to change of benefits) as contractors to ensure a smooth transition. Ensure a healthy NCSC that is actively engaged by senior management. Ensure that contractors are not driven to a "mission safe essential" program mentality where continuous improvement is sacrificed for cost savings. If split contracts are put in place, ensure contractors are incentivized to also promote overall site mission accomplishment (e.g., planning for and availability of service level agreements between contractors should be evaluated if multiple contractors are on the site.) Ensure that mission changes to be implemented in the future are not allowed to degrade the expectation for	Tasking 2020-01, What's Wrong with Criticality Safety Programs? 2020 version

	"excellent operation" at the current time. Ensure new contractors with new missions understand which limits and controls remain relevant to the operations being performed.	

ATTACHMENT A

CSSG Tasking 22-01

CSSG TASKING 2022-01
Date Issued: January 31, 2022

Task Title:

- CSSG Guidance to NNSA on Contract Transition Regarding Criticality Safety

Task Statement:

The CSSG has been requested to develop considerations to help NNSA oversight ensure successful contract transition for large Management & Operation, Management & Integration, and Indefinite Delivery Indefinite Quantity contracts from the perspective of Criticality Safety. This should be based on CSSG experiences with previous large NNSA/EM contract transitions (e.g., Livermore, LANL, Y-12/Pantex, INL/ICP, and Savannah River) and significant changes impacting criticality safety (organizational, funding, mission). This guidance is provided with the purpose of avoiding issues found during past transitions.

The scope of the review should consider including the following topics:

- Criticality safety practices in support of mission success.
    a. Proper use of conservatism/assumptions/process knowledge during Criticality Safety Evaluation Process
    b. Continuing criticality safety integration with Safety Basis and Operations.
    c. Development of relationships between the new contractor and the local field office.
    d. Potential unintended consequences of the contract language/incentives/timing on Criticality Safety
- Criticality Safety post transition and due diligence.
    a. Ability to understand and alleviate past criticality safety issues from the outgoing contractor (tribal knowledge).
    b. Criticality Safety organizational structure and position in the organization
    c. Criticality Safety staffing ability/retention of the new contractor coming into the contract.
    d. Knowledge transfer and collective knowledge retention among Criticality Safety practitioners.
    e. Criticality Safety Training and Qualification post transition.
    f. Maintenance of the criticality safety program at a level beyond “minimum mission essential”.
- Informed decision making on the continuation/support for Criticality Safety Committees.

Based on the past experiences the CSSG is to provide recommendations on any issues identified and proposed/alternative approaches. The intent of the review is for the CSSG to use its’ collective wisdom to provide guidance/alternatives for criticality safety oversight to be implemented by NNSA during and immediately after contract transition to provide additional certainty of mission execution and minimize the potential for rework due to operational or regulatory concerns post transition. If identified during the review, the CSSG can also provide any suggestions for approaches to be used by NNSA procurement to best evaluate, during the contract selection process, a prospective team’s ability to execute criticality safety.

The review should consist of:

- a kickoff meeting with the CSSG writing team, NNSA Field Officials (e.g., NPO nuclear safety, DOE-SR nuclear safety) responsible for Criticality Safety during/post transition, NNSA HQ/CDNS staff with criticality safety oversight responsibilities, DOE-NCSP leadership)
- recollections and reviews of previous CSSG reviews/taskings involving past transitions, significant changes impacting Criticality Safety, and/or subsequent issues,
- interviews of selected individuals,
- request for comments by the DOE CSCT,
- review by the full CSSG, and

- a tasking report and outbrief to NA-50 (others if requested).

To the extent practical, meetings and interviews should be done remotely to minimize face-to-face contact.

Period of Performance:

- The Task should kick off the effort by February 11, 2022, with the final version for posting to the NCSP website by April 30, 2022

Resources:

CSSG Task 2022-01 Team Members:

- Fitz Trumble (Team Leader)
- Dave Heinrichs (Livermore)
- David Hayes (LANL)
- Kevin Reynolds (Y-12)

- CSSG members will use their FY22 NCSP CSSG support funding as applicable.

Task Deliverables:

1. The Task Team will kick off the effort by Feb 11, 2022
2. Task Team prepare a draft by March 15, 2022.
3. CSCT provide review comments by March 22, 2022.
4. Full CSSG provide review comments by April 1, 2022.
5. Task Team provide final version of document to NCSP Manager for review and posting by April 15, 2022.

Task Completion Date: April 30, 2022

Signed: Angela S. Chambers Digitally signed by Angela S. Chambers Date: 2022.01.31 15:27:42 -06'00'

Angela Chambers, Manager US DOE NCSP
Office of the Chief of Defense Nuclear Safety, NA-511

ATTACHMENT B

Excerpt from NNSA Technical Bulletin 2017-1
The Greatest Threat to DOE Criticality Safety Programs

Section I. Technical Articles

Editor's Note: The following four articles reflect the opinions of the authors. NNSA does not necessarily endorse any of the conclusions presented; however, these articles are being published to inform readers and stimulate thought and discussion on the challenges that Department of Energy (DOE) safety programs face. Specifically the first article addresses concerns with DOE Criticality Safety Programs courtesy of Dr. McKamy's vast experience with these programs. Dr. McKamy left NNSA in November 2016 to join the Defense Nuclear Facilities Safety Board.

The Greatest Threat to DOE Criticality Safety Programs: Managing Change

Dr. Jerry N. McKamy, formerly with NA-511 staff

The single biggest threat to DOE criticality safety programs is unintended and undetected consequences due to change. This article is intended to document some of those past changes and stimulate thought on how DOE and its Contractors can best anticipate, detect and mitigate potential adverse impacts on criticality safety brought on by change.

Implementation of the ANSI/ANS-8 Standards and elimination of the practice of storing solution in unfavorable geometry vessels have dramatically reduced the frequency of criticality accidents in the U.S. and worldwide. The last U.S. criticality accidents in a NNSA defense facility occurred in 1958. From 1958 until 1989, there were no criticality accidents and no programmatic shutdowns in DOE facilities due to criticality safety concerns. However, there have continued to be major work stoppages at DOE facilities resulting in plant, laboratory, and facility shutdowns with enormous impacts on mission and costing the DOE millions of dollars to restore operations.

Here is a representative list of major DOE facility shutdowns due to criticality safety program problems:

- 1994-1996 Y-12 Enriched Uranium Operations due to Inadequate Conduct of Operations and Inadequate Documentation of the Criticality Safety Basis (DNFSB Recommendation 94-4)
- 1994-1995 Rocky Flats Plutonium Recovery Operations resulting from a near-miss criticality accident in Building 771
- 1996-1997 Rocky Flats Plutonium Stabilization Activities due to discovery of inadequate criticality safety mass controls of some legacy waste drums containing hydrogenous waste
- 1997-1998 Livermore National Laboratory (LLNL) B332 Plutonium and Stockpile Support Operations due to discovery of numerous criticality safety infractions

- 1998-1999 Hanford Plutonium Finishing Plant due to numerous criticality safety infractions
- 2007-2008 Los Alamos National Laboratory (LANL) PF-4 Plutonium Operations due to discovery of inadequate flowdown and implementation of controls from criticality safety evaluations
- 2013-2016 LANL PF-4 Plutonium Operations due to inadequate conduct of operations and disintegration of the nuclear criticality safety group.

In every instance cited above all the symptoms were produced by organization change which resulted in instability of the criticality safety function.

Changes that resulted in the instability in the criticality safety programs include the following:

- Abrupt Change in DOE Technical Expectations,
- Site/Lab Contract Change, and
- Mission Change.

The impacts of these changes can be rapid. It takes as little as six months for a robust, functioning, compliant criticality safety program to become completely ineffective. That's about how long it takes for senior technical managers to leave, senior technical staff to leave, and for management to reorganize the criticality safety function such that they are no longer independent of operations. This happened at LLNL in 1996. Sound criticality safety programs take 5-10 years to build from a state of disarray but can, and have been, destroyed in less than a year. These rapid changes in the health of criticality safety programs can go undetected by standard oversight and Contractor Assurance practices because these only look for the symptoms of problems which might not be detected until system collapse or an accident occurs.

Let's briefly look at the history of major facility shut-downs due to instability in the criticality safety function and then attempt to offer a way to monitor the onset of these issues before the consequences become inevitable.

Change in DOE Technical Expectations

In the early 1990s DOE changed its technical expectations for documentation of criticality safety evaluations. DOE went rapidly from accepting an 'expert based' system where the safety and operational knowledge resided in long-tenured personnel to requiring a 'standards based' system where everything related to analysis and control of the criticality accident hazard had to be documented in a way understood by DOE auditors. The pace of change in technical expectations could not keep up with the labs' and sites' ability to maintain safe operations, reconstitute criticality safety evaluations to new and emerging expectations, and revise operating procedures to drive increased formality. Y-12 was shut down by imposing this standards based expectation on the facility abruptly, largely due to the interaction of the Defense Nuclear Facilities Safety Board (DNFSB) and their Recommendation 94-4. The 1996 Rocky Flats shutdown was due to a backwards looking imposition of higher analysis and control expectations on

existing legacy waste drums. In both the Y-12 and Rocky Flats cases, nothing was actually unsafe as found. What was missing was documentation of the safety in a form that DOE could understand in light of its standards-based approach.

In subsequent years, as the Department moved systematically through its sites to standardize its criticality safety programs, the change to the standards/formality of operations base eventually caught LANL in 2005. In this case, LANL and DOE should have had ample warning and begun to transition towards a standards-based criticality safety program, but did not until forced to do so. It should be noted that the Los Alamos Site Office had no resident criticality safety subject matter expert on staff prior to 2005. The forcing function was an invited comprehensive criticality safety assessment of LANL by the DOE Criticality Safety Support Group (CSSG) in 2005. Subsequent to this review, the DNFSB staff discovered flawed criticality safety evaluations, failure to implement controls, and a failed configuration management system in the LANL PF-4 storage vault. Contributing to this situation in the storage vault was the loss of the criticality safety engineer who prepared the original evaluation and lack of knowledge transfer to those following him. Along the line a higher plutonium mass limit was approved without understanding the upset conditions and engineered controls required. The as-found condition of the PF-4 vault was safe but did not meet the ANSI/ANS-8 requirements for margin of subcriticality. This led to revising all the criticality safety evaluations for the vault and a redesign of storage shelves in Rooms B & I. The root-cause of the PF-4 stand-down and subsequent comprehensive Augmented Limit Review process for all criticality safety evaluations was the abrupt transition from an expert based system to a standards based system.

Contract Change

Contract change driven by DOE was a major reason for criticality safety problems at Hanford PFP in 1997 and contributed significantly to the LANL problems in the 2010-2013 time frame. In the former case, the Department experimented with a 'Management & Integration' (M&I) contract where site functions would be performed by multiple contractors, not the traditional Management & Operations Contractor. In the Hanford M&I case, the criticality safety function was actually outsourced to a sub-contractor located in another state and the criticality safety evaluations were literally mailed in based on task-orders from the site.

In the latter case with LANL, transition to a new contractor with its new articles of incorporation assigning mission functions to specific corporate teaming partners resulted in a change of senior safety management leadership leading to senior safety managers with virtually no comparable criticality safety experience. The major initiator for the collapse of the criticality safety program in this environment was the loss of an experienced senior manager with good working relationships with the criticality safety staff. A senior criticality expert reported directly to the Division Leader at the time. The replacement senior manager pushed the senior criticality expert down in the organization which accelerated the de-stabilization of the program, and eroded the independence from operations of the criticality safety function. Management actions led directly, almost deliberately, to the complete disintegration of the criticality safety function over a two

year period at which point the Laboratory was left with but a single junior qualified criticality safety engineer, culminating in the shutdown of PF-4 in 2013.

In 2011-2012 the NNSA and LANL had several formal written reports and briefings warning explicitly of the imminent demise of the criticality safety organization and loss of staff. The DOE Criticality Safety Support Group (CSSG) warned NNSA and LANL in 2012 that LANL would lose about 70% of its mission capability and take five years to recover.

Mission Change

Mission change played the dominant role in the 1994 and 1997 shutdowns of Rocky Flats and the Lawrence Livermore National Laboratory (LLNL), respectively. Rocky Flats was from inception a nuclear weapons component manufacturing plant. In the early 90's, with its change from a production site to a decommissioning site, Rocky Flats transitioned from the Office of Defense Programs to the Office of Environmental Management. The management culture flipped rapidly from a focus on safety and weapons production to being risk averse to environmental fines levied by the state of Colorado under Resource Conservation and Recovery Act (RCRA) laws. What was plutonium product one day was RCRA regulated waste the next. The workforce came to fear RCRA violations and fines more than a criticality accident and quickly began acting as if a criticality accident could not happen with so-called waste.

In the case of LLNL when DOE decided it no longer needed two fully capable national weapons laboratories with redundant plutonium capabilities, the University of California offered a voluntary early retirement program at LLNL and the long-tenured criticality safety manager and many senior staff retired. The criticality safety function and depleted remnant staff were rapidly split-up and made subservient to operations.

Two of these major facility shutdowns were anticipated and leading indicators were documented but all went unheeded for a year or more. The criticality safety manager at Rocky Flats wrote two formal warning memos to senior plant management during the year ahead of the August 1994 Building 771 near-miss event warning bluntly that a criticality accident was about to happen in that facility.

Again, these very explicit, documented warnings (both at Rocky Flats and at LANL) went unheeded by both the contractor and DOE because they didn't fit neatly into standard oversight boxes and the 'accident' hadn't happened yet.

Fixing the Problem

NNSA and DOE need to do a better job of change management, recognizing the importance of the individual managers and their expertise in maintaining stable criticality safety programs.

The proceedings of the 1999 Criticality Safety Self-Improvement Workshop document (page 13 of the presentation "What's Wrong with NCS Programs?") presents some

leading indicators of problems in maintaining a stable criticality safety function stemming from weaknesses in contractor management:

- Weak or Nonexistent Nuclear Criticality Safety Policy
  - Unclear Roles & Responsibilities
  - NCS Group and Staff Report Directly to the Line Operations (also manifests itself as 100% direct funding from Operations)
- The NCS Manager reports too low in the Organization
  - No Institutional (i.e. indirect) NCS Funding (this should be about 30% of the FTE equivalent for the NCS Staff)
  - No Management Assessments of NCS

When Contractor changes occur, DOE and NNSA should select key individuals on contracts who have demonstrated knowledge and skill in managing criticality safety. DOE and NNSA should select Contractors who propose organizations with criticality safety being clearly independent of operations, receiving substantial indirect funding under the control of the NCS manager, have the NCS Manager report no more than two levels below the plant president or lab director, and have a robust system whereby the plant president/lab director maintains awareness of the NCS program health. Contractor Management (in ANSI/ANS-8.19 vernacular this means line management up to and including the senior most official, not the criticality safety manager) should implement best practices for Nuclear Criticality Safety Committees as recommended by the DOE CSSG which may be found on the DOE Nuclear Criticality Safety Program website. A good example of a strong and vigorous Nuclear Criticality Safety Committee is the one put in place at LANL during the Laboratory's efforts to reconstruct their criticality safety program in the aftermath of the 2013 shutdown.

One of the least used leading indicator metrics from the 1999 Self-Improvement Workshop is the one of whether or not the contractor NCS Manager has about 30% Full Time Equivalent for the NCS staff worth of money at their discretion. For example, in the late 1997 time-frame, a Hanford facility had allocated only about $500k/yr. total to criticality safety leading up to the shut down when it is obvious that anything less than about $2-5M/yr. was the figure of merit for the operations and size of the facility.

Why is this metric so powerful? First, it ensures that the criticality safety staff is functionally independent of line operations as required by ANSI/ANS-8.19. Second, it permits the NCS Manager to provide for staff development in the form of participation in ANSI/ANS Standard Development, attendance and publication at national conferences, and participation in offsite and onsite technical professional development opportunities. This contributes to the ANSI/ANS-8.19 requirement for Management to provide personnel familiar with the physics of criticality and encourages stability in the NCS staff. Third, it permits the NCS Manager to allocate staff to addressing fundamental safety infrastructure needs (analogous to the old Readiness in Technical Base and Facilities program in NNSA operating budgets). No single line operations manager will fund these kinds of activities (i.e. new workstations, upgraded cross-section sets,

upgraded/updated monte-carlo codes, upgrading plant/lab wide legacy criticality safety evaluations with known deficiencies, producing standardized policies, programs, and procedures across the site/lab, etc.). This helps, in part, to address the ANSI/ANS-8.19 requirement to identify and correct deficiencies and prevent their recurrence and also the requirement for NCS staff to remain current in advances in the physics and technology of criticality safety.

The key backstop to early detection of unintended consequences of change is frequent communication with subject matter experts close to the work. The Department has qualified criticality safety personnel at its field and site offices. These professionals make up the Federal Criticality Safety Coordinating Team (CSCT). Senior DOE Management should engage in regular discussions with their respective CSCT members to identify rapidly changing conditions that could adversely affect criticality safety. Conventional audit and review strategies produce lagging indicators. Information on leading indicators (such as a senior manager leaving and reorganization of criticality safety or mass departure of senior criticality staff) come from regular free-flowing technical information (in the form of open discussion and dialog, not formal reports or metric reporting) from the field/site up the line management chain. This dialog is essential to be able to detect and mitigate adverse impacts of change with sufficient time to intervene.

Contract expectations, award fee structures, and funding allocation for the NCS group are useful leading predictors of the health and stability of the criticality safety function. The good news is that all of these recommended criteria and metrics are already part of the formal DOE infrastructure. They are incorporated into lines of inquiry in DOE-STD-1158 for contractor self-assessments. Reliance upon, and retention of, personnel by both Contractors and DOE who are familiar with the physics of nuclear criticality and with associated safety practices to furnish technical guidance appropriate to the scope of operations is essential. DOE management should rely upon the expertise resident in the DOE Criticality Safety Support Group (CSSG) working in concert with the Federal Criticality Safety Coordinating Team (CSCT) to anticipate and prevent criticality safety program instability at the earliest sign of onset.