Annual Report on Nuclear Criticality Safety Programs

A Defense Nuclear Facilities Safety Board (DNFSB) letter dated January 29, 2008, requested that the Department of Energy (DOE) address eight specific subject areas related to nuclear criticality safety in an Annual Report on Nuclear Criticality Safety (NCS) Programs. The closure plan for DNFSB Recommendation 97-2, *Continuation of Criticality Safety at Defense Nuclear Facilities in the Department of Energy,* required DOE (including the National Nuclear Security Administration (NNSA)) to report on these subject areas for their respective nuclear criticality safety programs. A January 13, 2009, letter from the Board to the Acting Deputy Secretary of Energy requested that DOE provide supplemental information in its Annual Report, increasing the number of subject areas to be addressed to eleven. This report summarizes the detailed information provided in the NNSA and DOE reports, included as Attachments 1 and 2 to this Enclosure.

The NNSA and overall point of contact for this report is Jerry Hicks. He may be reached at 505-845-6287. The EM point of contact for this report is Robert Wilson, who can be reached at 303-236-3666.

Table of Contents:

1. Performance Metrics 2
2. Contractor Staffing 6
3. Federal Staffing 7
4. Lessons Learned from Assessments 9
5. Lessons Learned from Design Reviews 10
6. Trending of Infractions 10
7. Follow up Reviews 15
8. DOE's plans for ensuring its standards provide sufficient and appropriate guidance for the review of NCS program element implementation, including the need for another technical standard or supplement to DOE Standard 1158. 15
9. Infraction Categorization 16
10. Leading and Lagging Indicators 16
11. The status of open issues identified in the previous year's annual report. 18
   11.1. Status of NNSA open issues from FY 2009 18
   11.2. Status of Open issues from EM from FY 2009 19
   11.3. Open issues for the FY 2011 Report 19

The NNSA sites are presented by site office from west to east as follows:

Livermore Site Office (LSO)	Lawrence Livermore National Laboratory (LLNL)
Los Alamos Site Office (LASO)	Los Alamos National Laboratory (LANL)
Nevada Site Office (NSO)	Nevada Nuclear Security Site (NNSS)
Pantex Site Office (PXSO)	Pantex Plant (Pantex)
Sandia Site Office (SSO)	Sandia National Laboratories (SNL)
Savannah River Site Office (SRSO) (includes the NNSA Office of Fissile Material Disposition (NA-26)	Savannah River Site, NNSA operations
Y-12 Site Office (YSO)	Y-12 National Security Complex (Y-12)

The EM sites are presented by field office from west to east as follows:

Richland Operations Office (RL)	CH2M-HILL Plateau Remediation Company (CHPRC) Washington Closure Hanford (WCH)
Office of River Protection (ORP)	Bechtel National, Inc. for the Waste Treatment Plant (WTP) Washington River Protection Solutions (WRPS) for the Tank Farms (Tank Farms)
Idaho Operations Office (ID)	CH2M-WG Idaho (CWI) for the Idaho Cleanup Project (CWI) Bechtel BWXT Idaho (BBWI) for the Advanced Mixed Waste Treatment Project (AMWTP)
Portsmouth/Paducah Project Office (PPPO)	LATAKY-Paducah LATA/Parallax-Portsmouth
Oak Ridge Office (OR)	TWPC (WAI) Bechtel Jacobs Company (BJC) Isotek Systems, LLC
Savannah River Operations Office (SR)	Savannah River Nuclear Solutions (SRNS) Savannah River Remediation (SRR) Parsons, EM operations

Below is a summary of the NNSA and EM detailed reports that address the eleven specific subject areas referenced in the DNFSB letters of January 29, 2008, and January 13, 2009.

Specific Subjects to be Addressed in the DOE Annual Report on Nuclear Criticality Safety (from the DNFSB letters of 01/29/08 and 01/13/09)

1. Performance Metrics

A site-by-site evaluation of contractor nuclear criticality safety performance measured against established criticality safety performance metrics, including an evaluation of this performance and actions taken by DOE Field Element Line Management to improve nuclear criticality safety and address known nuclear criticality safety program deficiencies.

The performance metrics used in DOE defense-related criticality safety programs are listed below by broad general areas. The NNSA site offices and EM field offices select metrics tailored to the processes and operations at their respective sites. Below are a listing of the metrics and a summary discussion for each site and field office, including the metrics used.

Nonconformances:

1) Proportion of criticality safety nonconformances identified by workers, supervisors, criticality safety staff, DOE oversight, and external to DOE personnel, in decreasing order of desirability
2) Timely identification and resolution of nonconformances
3) Number of repeated or similar criticality safety nonconformances
4) Highest severity level of criticality safety nonconformances
5) Number of spills of fissile solution greater than a specified threshold
6) Number of fissile solution leaks of any size

7) Number of inadvertent transfers of fissile solution (e.g., transfer destination or route incorrect)
8) Fissile operations conducted without a process evaluation for criticality safety
9) Number of nonconformances
10) Type of nonconformances
11) Root causes of nonconformances

Self-Assessments and Committees:
12) Timely performance and documentation of required audits or assessments
13) NCS staff presence in operations areas that have significant quantities of fissionable material

Staff Responsibilities:
14) Number of NCS non-managerial staff and fissile material handlers (FMHs) serving on working groups associated with an ANSI/ANS series 8 (criticality safety) Standard.
15) Number of in-house technical seminars prepared and presented by NCS staff
16) Percentage of the NCS engineering staff that is engaged in credited development activities (e.g., technical courses, conferences, graduate studies).
17) Percentage of NCS staff qualified to DOE-STD-1135, *Guidance for Nuclear Criticality Safety Engineer Training and Qualification*

Operations Training:
18) Percentage of contractor personnel completing FMH training when required.
19) Number of small group training sessions conducted with fissile material operations crews

Continuous Improvement:
20) Number and type of DOE comments on contractor criticality safety evaluations and the overall quality of those evaluations.
21) Progress toward program improvement milestones
22) Systematic identification of, and action taken on, improvement issues
23) Number of supplemental guidance documents issued to clarify or correct issued process evaluations for criticality safety
24) Schedule and cost performance for producing high-quality criticality safety evaluations

Conduct of Operations and Formality of Operations Metrics:
While these metrics are not normally tracked as part of the criticality safety program, they are important to criticality safety. Several sites use conduct of operations metrics as an adjunct to criticality safety metrics.

National Nuclear Security Administration

The NNSA sites have developed a robust set of metrics for monitoring the health of the local criticality safety programs. The most complete are at LLNL and Y-12. The contractors and the site offices have collaborated in developing these metrics. The metrics have proved useful in monitoring program improvements found necessary by assessments. Where the metric set for the site is well established, the metrics are useful in preventing program degradation.

Lawrence Livermore National Laboratory: The contractor met or exceeded all of the negotiated criticality safety performance metrics for fiscal year (FY) 2010, earning a score of

Excellent. The contractor significantly exceeded the minimum performance criteria in the areas of criticality safety self-assessments, continuing training for criticality safety engineers, support for DOE Nuclear Criticality Safety Program initiatives, participation in national consensus standards efforts, and criticality safety training for FMHs. Overall, the level of operational criticality safety infractions and deficiencies were minor during FY2010. All operational deficiencies were self-identified and corrected. Implementation of criticality safety controls was excellent.

Metrics used: 1, 2, 3, 4, 8, 12, 13 14, 15, 18

NNSA HQ judges the LSO/LLNL criticality safety metric set to be among the best in the complex. The metrics used are weighted by importance, and can be objectively rated.

Nevada Nuclear Security Site: Nuclear criticality safety performance by the contractor has been less than exemplary this year, with a satisfactory rating (less than 50% of expected performance). National Security Technologies, LLC (NSTec) demonstrated weaknesses in criticality safety program implementation, development and use of metrics, coordination with NNSA National Laboratory users, interface with NNSA emergency management, and in understanding of criticality safety evaluations and basic behavior of fissile systems.

Metrics used: 2, 3, 21
Metrics for FY 2011: 9, 12, 13, 18, 20

The NNSS metric set used in FY 2010 was inadequate to monitor the actual status of the program. In addition, NSTec failed to meet expectations on several program implementation deliverables directed by the site office. NSO has directed NSTec to respond with a better set of metrics for FY 2011, and provided a suggested set tailored to the site status and needs. NNSA HQ judges the effectiveness of metrics in criticality safety at NNSS to be unacceptable, and agrees with the current rating of the contractor by NSO as unsatisfactory in criticality safety.

Los Alamos National Laboratory: Criticality safety was measured as part of the Nuclear and High-Hazard Operations subjective performance-based initiative in FY 2010. The LASO criticality staff and management judged that the incentives should be placed on improvement of formality of operations and conduct of operations in FY 2010. NNSA HQ criticality staff agreed with this decision.

LASO's focus in FY 2010 was overseeing the Criticality Safety Improvement Plan (CSIP). This focus will continue through FY 2011. Completion of the CSIP was delayed in 2010 due to the need to address identified seismic concerns at the LANL Plutonium Facility. The CSIP is expected to be completed by the end of FY 2011. The CSIP remains divided into two sub-plans: Plan 1, focused on program and implementation improvements, and Plan 2, focused on upgrades to the process evaluations for criticality safety. LASO continues to review all process evaluations for criticality safety produced by LANL. LASO judges the evaluations to continue to be of high quality.

Metrics used: 20, 21, 22

NNSA HQ judges that the metrics reported and the incentives in use place the emphasis where it is needed to bring the program to full compliance.

Sandia National Laboratories: All established metrics were reported as satisfactorily met. Sandia has little criticality safety risk other than in the experimental operations with nominal 7% enriched uranium. The disposition of legacy materials from former fissile operations is proceeding carefully with documented trivial criticality risk. The experimental operations are also monitored periodically by SSO criticality staff.

Metrics used: 9, 12, 13, 16, 17

NNSA HQ judges the Sandia criticality safety and critical experiments safety programs to be commensurate with the risk. Since the SSO only assigns one individual 10% of his time to do the site office criticality safety oversight, there is a constant chance that the criticality safety work will be subsumed by other priorities.

Pantex Plant: Criticality safety metrics were met. The Pantex criticality safety program is judged acceptable. NA-17 staff assisted PXSO in an assessment of the contractor program in August 2010. The program was judged acceptable at that time. The Pantex contractor has reworked staff assignments to provide several people able to assist in criticality safety, while one person serves as the primary plant criticality safety engineer. The Pantex contractor also prepared a new criticality safety evaluation that closed a finding that had been open for several years.

Metrics used: 9, 16, 17, 20

NNSA HQ judges the metrics used by the Pantex criticality program to be adequate to assure program health, given the nature of operations and the overall risk.

Y-12 National Security Complex: The performance as measured by the NCS metrics showed improvement in the areas of deficiencies with a positive trend in all areas for the year. Additional flow-down metrics were developed and utilized to define location, operating area, type of issue, category, and causes. This information will be used to focus efforts on identifying specific issues that need to be addressed. Metrics looking at closures of NCS items, both minor non-compliances (MNCs) and deficiencies, showed steady improvement over the year. At the beginning of FY 2010, there were 34 MNCs and deficiencies that were open over 45 days. By the end of the year, that number had been reduced to 10. Both the self-reporting metric and the small group seminars showed outstanding performance for the year. Efforts have progressed on improving the quality of the process evaluations for criticality safety with the introduction of a process where new evaluations, fully compliant with DOE-STD-3007-2007, *Guidelines for Preparing Criticality Safety Evaluations at Department of Energy Non-Reactor Nuclear Facilities*, were graded against an established set of criteria. Results have shown outstanding grades for the nine evaluations graded to date. The metric for FY 2011 has been expanded to include all process evaluations for criticality safety that are revised.

Metrics used: 1, 2, 3, 5, 6, 7, 9, 10, 11, 12, 13, 16, 17, 19, 20, 21, 23
Metrics planned for FY 2011: 1, 2, 3, 5, 6, 7, 9, 10, 11, 12, 13, 16, 17, 19, 20, 21, 23, 24

Y-12 has a complex set of metrics, suitable for a mature program at a complex site, that target most areas of the program. NNSA HQ judges that an adequate set of criticality safety metrics exist at Y-12. In addition, NNSA HQ agrees with YSO that the metrics both identify areas where improvement is needed, and target the areas that have been identified as needing extra emphasis.

Savannah River Site Office: No fissionable materials operations are currently underway. NNSA HQ judges that no criticality safety performance metrics are needed.

Environmental Management

All operational EM contractors are measured against established performance metrics. The performance compared to these metrics is generally good. In addition, contractor performance in criticality safety is periodically assessed by internal and external organizations. These assessments typically result in corrective actions that lead to improved criticality safety performance.

Eleven of the 14 EM sites use counting of infractions as their principal criticality safety metric. Two of the sites are not yet operational, and therefore have no established metrics. One site uses several metrics rather than counting the number of infractions. Of the remaining eleven sites, four use only the number of infractions as a metric; two more use the number of infractions and time to close; another two use the number of infractions, time to close, and root cause; and the final three use the number of infractions and several other metrics.

Metrics Used: 2, 9, 10, 11, 12, 13, 14, 16, and 17

The HQ assessment is that EM sites could improve on application and use of metrics for monitoring the health of criticality safety programs.

2. Contractor Staffing

The status of the contractor nuclear criticality safety engineer programs at each site, including staffing levels, plans to address vacancies, interim compensatory measures, and progress on training and qualification. This must include an analysis of the adequacy of each by DOE Field Element Line Management.

The NNSA and EM contractors in general have difficulty hiring and retaining qualified criticality safety staff. This includes the development path of hiring recent graduates and training them in criticality safety. Attracting engineers from other disciplines to criticality safety from within a site frequently proves difficult also.

Some sites have received assistance from other sites nearby or with similar expertise. Y-12 has solicited, and has agreement in principle, to receive help from ORNL criticality safety staff. Operations at NNSS have been assisted by both LANL and LLNL staff. LLNL assistance in CEF operations has helped cover work that the LANL home shop did not have available staff to do at the time.

The table below shows the contractor criticality safety staffing levels at each of the NNSA and EM sites, and the line management judgment of whether staffing is adequate. Mission work has been slowed or delayed in both Y-12 and LANL operations.

Table 1: Contractor Criticality Safety Staffing

Site	Contractor criticality safety staff, end of FY 2010	Status
LLNL	8	Adequate
NNSS	4 (2 still need site-specific qualifications)	Adequate, perhaps overstaffed

Table 1: Contractor Criticality Safety Staffing		
Site	**Contractor criticality safety staff, end of FY 2010**	**Status**
LANL	12 (includes manager and senior advisor) plus 2 available consultants	Understaffed. Hiring has proven difficult over the last 2 years. Some mission delay has occurred for local operations. LLNL has assisted in some CEF operations at NNSS.
SNL	10 (only one near full-time, 2 full-time equivalents (FTEs) of work)	Adequate
Pantex	3 Approximately 1.75 FTEs; two qualified, one in qualification	Adequate
Y-12	20.25 FTEs, including 2 awaiting clearance; 5 management and senior staff; subcontract: 13.6 FTEs (about 34 FTEs total)	Understaffed Some mission delay occurs. Increased effectiveness and contract support is being sought.
Richland – CHPRC	10 (1 in qualification)	Adequate but minimal
Richland – WCH	1	Adequate
River Protection – WTP (Bechtel)	1 plus manager	Adequate; one criticality safety engineer in training
River Protection – Tank Farms (WRPS)	2	Adequate, but needs monitoring by EM HQ
Idaho – CWI	4 (includes manager)	Adequate
Idaho – BBWI AMWTP	3 FTEs	Adequate
PPPO – Paducah-LATAKY	1.25	Adequate
PPPO – Portsmouth-LATA/Parallax	4	Understaffed by 2; the site is recruiting and using overtime.
Oak Ridge – Transuranic Waste Processing Center TWPC (WAI)	Approximately 1 FTE, 2 primary, 3 on call	Adequate
Oak Ridge – BJC	9	Adequate
Oak Ridge – Isotek	6 plus 1 part-time	Adequate
Savannah River - SRNS	26 (11 fully qualified Senior Engineers; 7 fully qualified Engineers; 8 in training)	Adequate; recruiting in progress
Savannah River - SRR	3 (fully qualified , 1 working to become qualified)	Adequate
Savannah River- Parsons	2	Adequate

3. Federal Staffing

The status of the Federal nuclear criticality safety engineer programs at each site, including staffing levels, plans to address vacancies, interim compensatory measures, and progress on training and qualification. This must include an analysis of the adequacy of each by DOE HQ Line Management.

NNSA HQ line management judges the Federal staffing at the Sandia Site Office (SSO) to be adequate, given the commensurate NCS program at SNL. The Service Center also augments SSO NCS staff. NSO lost its Federal criticality staff to the NNSA Service Center to serve in a function other than criticality safety. There are also some issues with qualification gaps. With the startup of the Criticality Experiments Facility (CEF) at Nevada and a potential increase in critical experiment capability at Sandia, it is imperative that NSO fill the NCS position quickly. Hiring actions are in progress at Nevada. NNSA HQ will continue to monitor the criticality safety status of the NNSA sites, and will assist the sites accordingly. NSO is receiving assistance in criticality safety program improvement and with the CEF startup from NNSA HQ, the NNSA Service Center, LASO, and LSO. The site by site status of federal staffing is given in Table 2.

EM staffing shortages are being addressed by training personnel from outside the discipline at Richland, and River Protection, and by contracted support at Portsmouth Paducah Project Office and Oak Ridge. Shortages at Savannah River are being addressed by seeking hiring authority. EM shortfalls are being addressed in the interim by support from EM HQ staff.

Table 2: Federal Criticality Safety Staffing

Site or Field Office	Federal Criticality Safety Staff (Full Time Equivalent)	Status
Livermore	1	Adequate
Nevada	0. Hiring in progress, some support from the Service Center, LASO, and LSO.	Understaffed
Los Alamos	1	Adequate
Sandia	0.1; support available from the Service Center	Adequate
Pantex	0.25	Adequate
Y-12	1. Some support available from the Service Center. YSO is pursuing obtaining contract support.	Adequate (YSO relies on contract support for the Uranium Processing Facility Project, but the main site is adequately staffed)
NNSA Service Center (Assists other sites and HQ)	1.25	Understaffed for the current workload
Savannah River Site Office (no operations, design only)	0.5	Adequate
Richland	0. An MOA has been executed with ORP for support.	Adequate; a member of the nuclear safety staff is working to become qualified as a criticality safety engineer
River Protection	1, plus 2 in qualification	Understaffed
Idaho	3	Adequate
PPPO	2.5 FTEs (including subcontract)	Understaffed
Oak Ridge	1.5 FTEs (including subcontract)	Understaffed

Table 2: Federal Criticality Safety Staffing		
Site or Field Office	**Federal Criticality Safety Staff (Full Time Equivalent)**	**Status**
Savannah River (EM)	2 (including 1 in qualification); the site is seeking authority to recruit additional staff.	Understaffed

4. Lessons Learned from Assessments

A summary of the results and any lessons learned from federal assessments of criticality safety conducted throughout the year and the steps taken by the contractor and DOE in response to these assessments. This summary should highlight such factors as the quality of contractor self-assessments, the adequacy of criticality safety evaluations, and the consistency of sites' nuclear criticality safety programs.

In most cases, contractor self-assessments are adequate; however, one contractor self-assessment was observed where the assessment team criticized the contractor for complying with DOE requirements. Federal assessments of criticality safety evaluations vary widely in sampling extent, from a small sample to all of the evaluations at a complex site. Evaluation quality is generally acceptable, with some sites still executing improvement plans. Federal assessments usually identify errors in the program, ranging from a few persons with expired training to fundamental misunderstandings of where responsibility for safety must lie (e.g., ignorance of the concept of line management responsibility for safety as stated in ANSI/ANS 8.1 § 4.1.1).

Two useful lessons can be learned from Federal assessment results over the past two years: one is that several part-time staff can combine to make an effective program. This is a very positive lesson for sites with small programs; however, there could be considerable risk if the program is not properly managed. SNL currently has 10 personnel qualified in criticality safety, several of whom are active in the larger community, although its criticality safety FTE budget is approximately two. Pantex applied this model over the last year, recovering from a severely understaffed program to an adequate program.

The second lesson to be learned from federal assessments is the need to leverage expertise to manage risk. The management and staff at one site were unwilling to address the risk of inadvertent criticality in an experimental facility, partly because it was outside the scope of the ANS-8 Standards, and for other unknown reasons. This was discovered in the CEF operational readiness review (ORR). The ORR team concluded that, in general, the emergency preparedness at the site was good; however, personnel demonstrated a lack of ability to deal with an unintended criticality in the experimental systems. There were personnel on the site during the exercise planning who could have provided the correct guidance, but this expertise was not utilized.

A third area that has been highlighted by Federal assessments is the necessity for safety to be owned by the doers of work and their line management. This is cannot be called a lesson learned; it has been in the ANS-8 standards and their predecessors for over four decades and in the DOE directives for one or two decades.

Another lesson learned is that DOE HQ must continue to maintain operational awareness of the state of the criticality programs at the sites. A HQ assessment of one site noted that

assessment findings from the site office were not being addressed in a timely manner, and several of these had to do with the quality of process evaluations for criticality safety. These issues included both errors in calculation and missed scenarios. Corrective actions are underway at this site, and appear to be having the proper effect. Management changes appear to have had the desired effect in addressing these issues, and NNSA is continuing to monitor the progress.

5. Lessons Learned from Design Reviews

A summary of the results and lessons learned from contractor, federal, or independent reviews of proposed nuclear criticality safety controls and design requirements for new facility designs. Included with this is a description of how this information was used by the contractor and DOE Line Management Elements to improve facility designs and the design process.

A recurring lesson learned from the reviews of design projects is that the earlier the safety disciplines are involved, the more probable the operational success of the project, and the lower the cost for engineered safety. The DOE Nuclear Criticality Safety Program (NCSP) has engaged the Criticality Safety Support Group (CSSG) to provide guidance proper conservatism in design and with respect to such conservatism in the DOE Directives Process.

The Uranium Processing Facility, Chemistry and Metallurgy Research Replacement, and Pit Disassembly and Conversion projects have all now integrated criticality safety features into the design in accordance with site criticality safety guidance. All three projects have criticality safety guidance documentation similar to process evaluations for criticality safety, but at a detail level commensurate with leading the design.

Line management elements have conducted reviews in accordance with DOE-STD 1189, and in some cases more frequently, to verify that the design work is correctly incorporating nuclear and criticality safety work.

6. Trending of Infractions

A summary of the results of trending and analysis of each site's reportable and non-reportable occurrences related to criticality.

NNSA HQ comments:
The infraction rate at LANL has increased in the last year, and dramatically in the last 6 months. However, the discovery of discrepancies by operations staff instead of criticality safety or other staff has also increased. This attributed in part to the maturation of the program as LASO emphasizes formality of operations with respect to the criticality safety program, and in part to line supervision becoming more aware that responsibility for safety belongs to the line rather than safety advisory groups. As discussed below, the infraction rate at Y-12 has been decreasing steadily, and with continued effort should soon approach the minimum rate reasonable for operations where human error rates are a factor.

Lawrence Livermore National Laboratory (LLNL)

In FY 2010, LLNL had two criticality safety infractions, one event that almost resulted in an infraction, and an equipment failure with criticality safety ramifications. Both infractions were determined to be below the reporting thresholds for the Occurrence Reporting System. Overall,

the level of operational criticality safety infractions and deficiencies at LLNL were minor during FY 2010. All operational deficiencies were self-identified.

Nevada Nuclear Security Site (NNSS)

One infraction occurred in FY 2010. The response to this infraction prompted NSO to recommend that NSTec modify their NCS program to clearly state the requirements for infraction response.

Los Alamos National Laboratory (LANL)

There were four occurrences reported in the Occurrence Reporting and Processing System (ORPS) and 11 that were categorized as non-reportable in FY 2010. The reportable occurrences were categorized in the as management concerns at a significance category of 2 or 3, consisting of one or more criticality safety infractions. The non-reportable occurrences were individual criticality safety infractions.

LASO trending of the infraction data from previous years demonstrates that there was a significant increase in the infraction rate in 2010. The infractions were then grouped to evaluate trends in causal factors; the following was determined:

- Four of the 23 infractions were related to legacy issues in the facility, and were discovered by facility personnel with assistance from LANL criticality safety staff. Because the causal factors pointed to poor implementation of the program in previous years, these were excluded from further trending for 2010.
- Eighteen of the remaining 19 infractions were caused by poor program implementation and weaknesses in formality of operations. These weaknesses included procedure adherence, processes not matching the evaluated process description, operator training to requirements, and a lack of clear communications in material definition.
- The remaining infraction was a result of poor definition of criticality safety limits by the criticality safety analyst that caused an infraction trap.
- Eight infractions were found as a result of the extent-of-condition review undertaken by TA-55 management in response to a Level 1 noncompliance. At LANL, a level 1 infraction is loss of control such that a criticality accident is possible or has occurred. A level 1 non-compliance is the administrative equivalent of a near miss or an accident, and is defined in the LANL program as “Operations are being conducted with fissionable materials above the threshold values listed [in Table 1 of LANL SD-130] without criticality safety guidance. It is the intent of LANL and LASO that level 1 non-compliances are serious.
- More than 80 percent of the infractions were discovered by facility operations personnel, and more than 90 percent were self-identified by LANL staff.
- There was minimal impact to the safety margin at the facility, even in the Level 1 noncompliance events. These six events, while significant from a compliance and program implementation perspective, involved small mass quantities of fissile material or material with robust geometry control.

Correlating the infraction rate increase and the causal factors with assessment and operational awareness information resulted in the following conclusions:

- Formality of operations implementation at TA-55 is not yet mature.
- Criticality Safety program implementation at TA-55 is incomplete.
- The awareness of criticality safety limits and requirements is improving at the facility.

LANL is taking proactive steps to correct the identified issues. Corrective action planning in response to the significance category 2 events reported in ORPS includes both formality of operations improvements and criticality safety program implementation. The increased awareness at the floor level is a positive step to program implementation. LASO assesses these actions to be a positive step toward a compliant criticality safety program at the site and a natural result of the LANL criticality safety program improvement plan. The LASO criticality safety subject matter expert is working in close coordination with the facility representatives at TA-55 to provide oversight of the corrective action management related to these events.

SNL

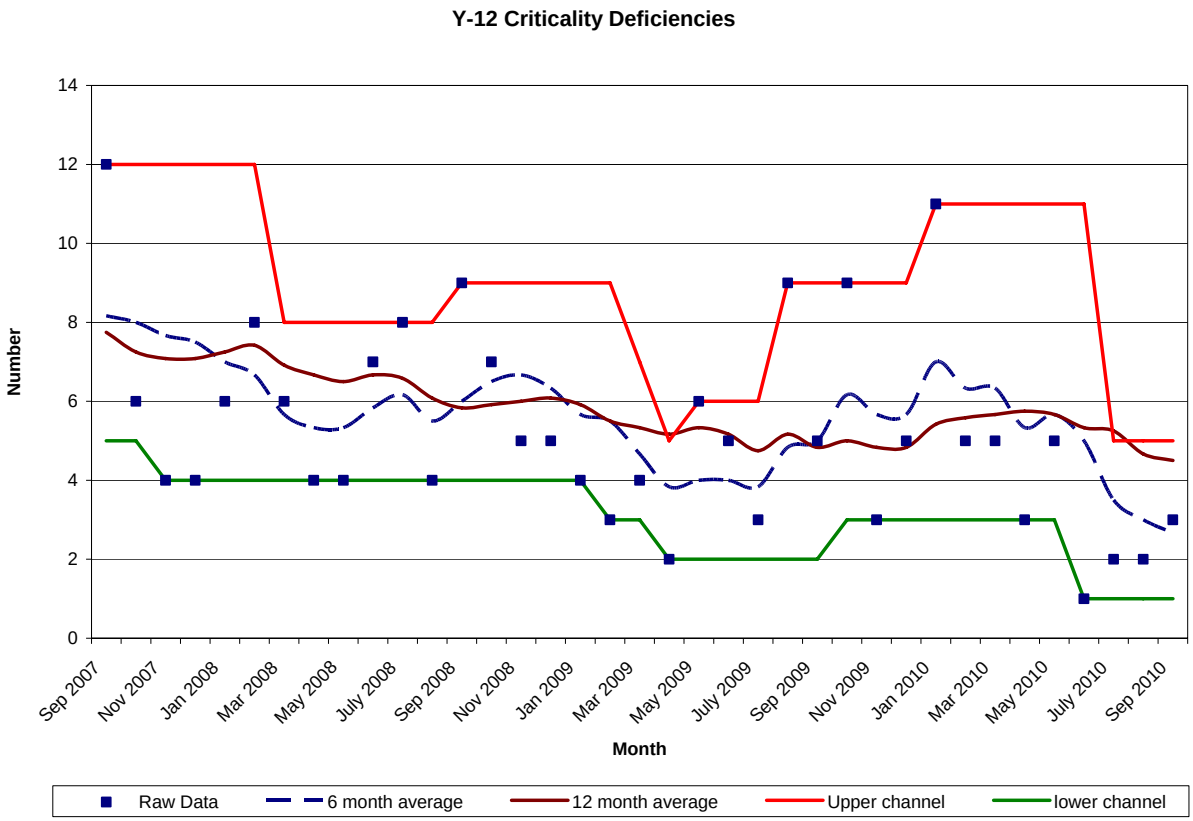
There were no criticality safety occurrences at SNL in FY 2010.

Pantex Plant

There were no criticality safety occurrences at Pantex in FY 2010.

Y-12 National Security Complex

Y-12, in recent years, has had enough deficiencies and minor non-compliances to provide sufficient data for statistical analysis. However, if the observed downward trend continues, the data set will be too small to draw statistical conclusions. It appears that if Y-12 is able to maintain the current trend, the infraction rate could be less than one per month within a year. The chart below illustrates the use of leading and lagging indicators. The predictive ability of these indicators is not absolute; however, the combination of indicators predicts that the infraction rate will continue to decrease. When the upper and lower channels form a pinch point, as in about April 2009, a change should be expected. The difference between the long-term and short-term averages indicates the direction of the change; if the long-term average is above the short-term average, the number can be expected to increase; if reversed, the number can be expected to decrease. This has been observed since about 2005 at Y-12. The rate has fallen from about six per month in 2006 to about three per month in 2010.



Savannah River Site Office (NNSA)

No fissionable materials operations are currently underway.

Environmental Management

EM HQ analysis:

The trending of occurrences at EM sites identified several causal factors, some of which were common to several sites. These include:

- the labeling of stored materials,
- legacy issues,
- inadequate knowledge of previous plant conditions,
- management issues,
- communications issues,

and

- reliability of administrative controls being less than desired.

Richland –CHPRC

Due largely to the continually evolving status of the site D&D process, the CHPRC has experienced 20 total nonconformance events in the past year. Four nonconformance issues were reported at the Waste and Fuels Project involving the labeling, handling, and spacing of waste drums containing fissile material. Additionally, at the Spent Nuclear Fuels Project,

problems were discovered in criticality safety evaluation reports (CSERs) supporting operations at the K-Basins Facilities. These problems and the associated PISAs resulted in declaration of two nonconformances in criticality safety. Several processing operations in the K-Basins were stopped pending closure of these safety issues.

PPPO-Paducah

Based on the trend analysis, management problems related to prior operations at the site are the leading cause of anomalous conditions. Most Anomalous Condition Reports involve the discovery of conditions that differ from prior accepted knowledge. These conditions have generally been assigned to “Management Problems.”

PPPO-Portsmouth

A review of the ACRs and associated problem reports indicate that the principle weakness in the NCS Program is planning for legacy issues that arise. LPP developed an NCSE to cover legacy materials of greater than expected normal mass limits in the process building, which reduced the number of ACRs in the process buildings. As LPP is moving into final stages of environmental clean-up and waste preparation and shipment, some legacy containers have been discovered outside the process buildings that have greater than safe mass conditions. Most of the ACRs in 2010 are due to these conditions.

OR-BJC

Trending has revealed a few common issues that have resulted in a request for a specific management assessment of the BJC NCS control implementation process (MA will be conducted during 1st quarter FY2011).

SRS-Savannah River Nuclear Solutions and Savannah River Remediation

The results of the M&O contractor’s NCSRC indicator are used to establish goals to reduce occurrences in specific causal areas. Based on 2006 results, a goal was established for 2007 to reduce the number of instrument problems and human performance problems by 20%. The goal was met. However, the number of management problems and communication problems increased during 2007. Human Performance Improvement (HPI) training for managers, engineers, and operators began in 2007 and continued into 2008. The result was a modest reduction in the number of management and communications problems during 2008 and 2009. Human Performance Improvement techniques continue to be emphasized in an effort to improve the reliability of administrative controls. During 2009 and the first three quarters of 2010, there was an increase in the number of minor events (< procedure limit violation) and the simultaneous decrease in the number of procedure limit violations.

The results of the criticality safety Performance Assessments were used to inform NCSRC members, management, and engineering of the need to continue to perform management observed evolutions and procedure improvement initiatives. Results also were used to review the number of contractor criticality safety engineer facility walkthroughs and participation in facility criticality safety self-assessments. Finally, results were also used to reconstitute area criticality safety committees after contractor transition and reorganization.

7. Follow up Reviews

The results of follow-up reviews undertaken by DOE to assess and validate the effectiveness of corrective actions and improvements from the above activities for the previous year

At NNSS, the results of follow-up reviews remain less than satisfactory. NSTec missed a milestone for submission of a revised program in February, submitted a revised program with an inadequate implementation plan in June, and still has not implemented the revisions directed by NSO in November 2009.

At LANL, the results of follow-up reviews have not met expectations. However, progress is occurring. Implementation is evaluated to be largely compliant in the areas of management responsibilities, criticality safety staff responsibilities, materials control, and planned response to criticality accidents. Improved implementation of the formality of operations program should correct most of the issues in the area of operating procedures, from a criticality safety perspective. The progress on completing criticality safety evaluation upgrades is less than desired, but judged adequate.

In previous years, several issues have been identified in assessments of the Y-12 criticality safety program. B&W Y-12 has written a program improvement plan to address these issues. YSO meets weekly with the contractor to review progress on implementing their NCS Improvement Program. Executing this significant program is essential to Y-12's achieving effective corrective actions and needed improvements the site NCS Program. The improvement program is the major focus for realizing meaningful NCS corrective actions and its implementation is being carefully monitored by the contractor's plant Nuclear Criticality Safety Committee and YSO.

In EM facilities and operations, NCS assessments by EM Headquarters, field offices, and contractors identified criticality safety issues and opportunities for improvement that resulted in corrective actions. Those actions are tracked to closure. Follow-up assessments are conducted as necessary to verify completion of corrective actions and evaluate the improvement in the criticality safety program.

8. DOE's plans for ensuring its standards provide sufficient and appropriate guidance for the review of NCS program element implementation, including the need for another technical standard or supplement to DOE Standard 1158.

DOE-STD-1158 was revised in 2009 to be consistent with the current ANSI/ANS Series 8 Standards. ANSI/ANS 8.1, *Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors,* is in revision. When this revision is completed, DOE-STD-3007 will also need to be updated. DOE O 420.1B, *Facility Safety*, will also need to be updated when ANSI/ANS 8.1 is revised. DOE is currently revising DOE O 420.1B and DOE O 420.2B, *Safety of Accelerator Facilities*. ANSI/ANS-1, *Conduct of Critical Experiments,* and ANSI/ANS-14.1, *Operation of Fast Pulse Reactors*, need to be added to the facility safety directive as mandatory standards. At least one accelerator facility is evaluating the use of high-multiplication (M ~ 50 to 100) targets. Accelerators have traditionally had minimal criticality concerns. However, at these levels of multiplication, criticality is not a minimal concern. DOE is planning to add the ANSI/ANS-8 series to the revision to DOE O 420.2B to ensure that criticality safety is properly addressed in these operations.

9. Infraction Categorization

The approach to be used by DOE to ensure that the categorization of NCS non-compliances is consistent, so that the correct root causes, corrective actions, and lessons learned will be identified.

The CSSG recommended a categorization scheme in 2009 (CSSG Tasking 2009-02, March 2009). This has been posted to the NCSP website as guidance [hyperlinked here]. The NNSA and EM sites with fissionable materials operations have a categorization scheme similar to this in their approved criticality safety programs. This item is complete, and will not be reported on next year.

10. Leading and Lagging Indicators

An initial list of leading and lagging indicators for monitoring the effectiveness of NCS program implementation.

The indicators used are the metrics given in section 1. Indicators dealing with capability, such as staff training and staff availability to the field, are usually leading, as are indicators that show operational awareness compared to safety requirements (i.e., who finds the infraction first). Indicators that show only that something has happened are lagging, unless analysis is applied to the rates of occurrence. The table below divides the currently used set of indicators into leading and lagging, with some commentary.

Table 3: Leading and Lagging Indicators	
Leading	**Lagging**
1) Proportion of criticality safety nonconformances identified by workers, supervisors, criticality safety staff, DOE oversight, and external to DOE personnel, in decreasing order of desirability	3) Number of repeated or similar criticality safety nonconformances
2) Timely identification and resolution of non-conformances	4) Highest severity level of criticality safety nonconformances
13) NCS staff presence in the operations areas having significant quantities of fissionable material:	5) Number of spills of fissile solution greater than a specified threshold
14) Number of NCS nonmanagerial staff and FMHs serving on any ANSI/ANS-8 Standard working groups	6) Number of fissile solution leaks of any size
15) Number of in-house technical seminars prepared and presented by NCS staff	7) Number of inadvertent transfers of fissile solution (e.g., transfer destination or route incorrect)
16) Percentage of the NCS engineering staff that is engaged in development activities (e.g., technical courses, conferences, graduate studies)	8) Fissile operations conducted without a process evaluation for criticality safety
17) Percentage of NCS staff qualified to DOE-STD-1135 or ANSI/ANS 8.26	12) Timely performance and documentation of required audits or assessments
18) Percentage of contractor personnel completing fissile material handler training when required	20) Number and type of DOE comments on contractor criticality safety evaluations and the quality of criticality safety evaluations
19) Number of small group training sessions conducted with fissile material operations crews	22) Systematic identification of, and action taken on, improvement issues
21) Progress toward program improvement milestones	23) Number of supplemental guidance documents issued to clarify or correct criticality safety evaluations
Control charting and rate of change may allow extracting leading information from #24	24) Schedule and cost performance for producing high-quality criticality safety evaluations
Note: Merely counting the rate of nonconformances will only lead to under-reporting. This is the most common and most dangerous metric. That is why these are listed last. See the Y-12 discussion in section 6 for an example of methods for extracting leading information from the rate of nonconformances. Also, root causes of non-conformances are not a good metric, as recurrence control is a requirement of ANSI/ANS 8.1 § 4.1.5 and ANSI/ANS 8.19 § 7.7.	
Control charting and rate of change may allow extracting leading information from #9.	9) Number of nonconformances
10) Type of nonconformances	11) Root causes of nonconformances

This section will not be repeated in future reports. The data table will be moved to section 1, and expanded as new metrics are developed. DOE will continue to identify metrics and best practices for leading and lagging criticality safety indicators as part of continuous improvement.

11. The status of open issues identified in the previous year's annual report.

More detailed descriptions of site-specific issues for NNSA and EM sites are provided in Appendices 1 and 2 to this report.

11.1. Status of NNSA open issues from FY 2009

LANL NCS Program Implementation
The LANL NCS Program does not yet fully meet the requirements in the ANS-8 standards. The issues are with legacy evaluations, operations ownership of safety, and formality of operations. Although schedules for correcting the legacy evaluations have slipped, significant progress was made. The LANL Criticality Safety Improvement Plan is now planned to be completed in Fiscal Year 2011. Operations ownership of safety and formality of operations have been emphasized with performance incentives by the Site Office, and are improving.

Pantex
A satisfactory sitewide criticality safety evaluation was produced and verified by NNSA reviews. This closed an item that had been open for several years. Pantex has developed some depth in their criticality safety staffing, as discussed above. This item is closed.

Contractor Staffing Shortages

These will persist for some time. The only viable way to increase staff is to develop staff from outside the discipline. The identified shortages are listed below.

Y-12 – Still short
LANL – Still short
Pantex – Staffing is now considered adequate
NNSS – Fixed, perhaps overstaffed

Federal staffing shortages:

NNSA Headquarters line management judges the federal staffing at SSO to be adequate, given the commensurate NCS program at SNL. The NNSA Service Center also augments SSO NCS staff. NSO lost their federal criticality staff to the NNSA Service Center in a function other than that of criticality safety. Hiring actions are in progress at Nevada. With the startup of CEF at Nevada and a potential increase in critical experiment capability at Sandia, it is imperative that NSO fill the NCS position quickly. NNSA Headquarters will continue to monitor the criticality safety status of the NNSA complex, and develop contingent actions, such as those discussed in item 3, as necessary.

EM staffing shortages are being addressed by training personnel from outside the discipline at Richland, and River Protection, and by contracted support at Portsmouth Paducah Project Office and Oak Ridge. Shortages at Savannah River are being addressed by seeking hiring authority. EM shortfalls are being addressed in the interim by support from EM HQ staff.

UPF Design review results:

The most significant finding related to NCS expressed was a concern that the gap between Criticality Safety Process Studies and the preliminary design could widen because of the schedule for updating the process studies. A detailed plan for updating the process studies has

recently been developed and will be included in the next revision of the Safety Design Strategy. This plan is aligned with the development of the safety basis documents. Another concern noted was the uncertainty in how automated rule checking will be used to verify NCS controls. Work is underway to provide clarity in the process studies on automated rule checking. The UPF project has implemented formal project control methods to assure that engineering controls identified as needed by criticality safety process studies are incorporated into the design.

Reviews at Nevada National Security Site

NNSA has identified actions to address CEF issues identified by the Board in their August 5, 2010 letter. In addition, the CEF operational readiness review (ORR), conducted in July 2010, performed a comprehensive review of criticality and reactor safety for the startup of CEF, including compliance to ANSI/ANS-8 and ANSI/ANS-1 provisions. The ORR identified pre-start findings for the integration of criticality safety considerations into emergency planning and response implementing documents, and the defensibility of the current CEF Criticality Accident Alarm System needs analysis, based on the final CEF criticality safety evaluations. Also, a pre-start finding was identified for startup planning for Godiva operations to assemble and characterize the critical assembly being incomplete. Corrective action plans have been developed for these findings.

The Board requested in January 2009 that DOE address its plans for ensuring its standards provide sufficient and appropriate guidance for the review of NCS program elements, including the need for another technical standard or supplement to DOE Standard 1158. A revision of DOE-STD-1158, *Self-Assessment Standard for DOE Contractor Criticality Safety Programs*, was issued in the third quarter of FY 2010. This issue is closed.

11.2. Status of Open issues from EM from FY 2009

No open issues from EM for 2009 were identified.

11.3. Open issues for the FY 2011 Report

- Contractor criticality safety staff levels
- Federal criticality safety staff levels
- Continued metrics development
- Criticality safety related directives
- Potential revision of DOE-STD-3007-2007, *Guidelines for Preparing Criticality Safety Evaluations at Department of Energy Non-Reactor Nuclear Facilities*