

**Office of Health, Safety and Security
Office of Enforcement and Oversight**

**Independent Oversight Review of
Nevada Site Office Criticality Safety Assessments
at the Criticality Experiments Facility and
Training Assembly for Criticality Safety and
Appraisal of the Criticality Experiments Facility
Startup Plan**



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Acronyms

ANS	American Nuclear Society
ANSI	American National Standards Institute
CAP	Corrective Action Plan
CDNS	Chief of Defense Nuclear Safety
CEF	Criticality Experiments Facility
CRAD	Criteria and Review Approach Documents
CSP	Criticality Safety Plan
DAF	Device Assembly Facility
DOE	Department of Energy
DSA	Documented Safety Analysis
ESH&Q	Environment, Safety, Health, and Quality
FMH	Fissile Material Handling
HSS	Office of Health, Safety and Security
JNPO	Joint Nevada Project Office
LANL	Los Alamos national Laboratory
LLNL	Lawrence Livermore National Laboratory
MSA	Management Self-Assessment
NCS	Nuclear Criticality Safety
NCSP	Nuclear Criticality Safety Program
NNSA	National Nuclear Security Administration
NNSS	Nevada National Security Site
NSO	Nevada Site Office
NSTec	National Security Technologies, LLC
NTS	Nevada Test Site
ORR	Operational Readiness Review
SSW	Senior Supervisory Watch
TACS	Training Assembly for Criticality Safety
TSR	Technical Safety Requirement

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1.0 PURPOSE

The purpose of this independent review by the U.S. Department of Energy (DOE) Office of Safety and Emergency Management (Independent Oversight), within the Office of Health, Safety and Security (HSS), was to shadow¹ the Nevada Site Office (NSO) line oversight activities conducted August 29 – September 2, 2011, to determine the level of compliance of Los Alamos National Laboratory (LANL) and Lawrence Livermore National Laboratory (LLNL) with American National Standards Institute and American Nuclear Society (ANSI/ANS)-8 standards for the handling and storage of fissile material in the Criticality Experiments Facility (CEF)² and with the LLNL Training Assembly for Criticality Safety (TACS) operations at the Device Assembly Facility (DAF).

This Independent Oversight review shadowed the NSO review team and focused on NSO's conduct of functional area assessments in accordance with NSO O 226.XC, *Assessment and Oversight*, and the contractor's compliance with fissile material handling and storage requirements. Additionally, this Independent Oversight review included a separate appraisal of the adequacy of CEF-PLA-013, *Startup Plan for the Criticality Experiments Facility*, in accordance with the requirements of National Security Technologies, LLC (NSTec) Company Manual CM-NOPS.001-006, *Developing the Startup Plan*, the level of NSO line oversight of and contractor compliance with the Startup Plan, and the status of corrective actions to close out issues identified in previous reviews.

These oversight activities were conducted in accordance with the HSS *Office of Safety and Emergency Management Evaluations Protocol for Small Team Oversight Activities*, dated May 2011, and with the HSS *Plan for the Independent Review of the Nevada Site Office Criticality Experiments Facility and Training Assembly for Criticality Safety Criticality Safety Assessment*, dated August 17, 2011.

2.0 BACKGROUND

The National Nuclear Security Administration (NNSA) conducted an operational readiness review (ORR) for the CEF startup July 19-28, 2010, to verify the readiness of the hazard category 2 CEF at the Nevada National Security Site (NNSS) to commence operations in accordance with the approved safety basis. The CEF is housed in the existing DAF and is covered by an addendum to the DAF Safety Basis. The ORR concluded that the criticality safety program for CEF was weak, and issues were noted in the program procedures, experiment design and review, and adherence to procedures. The ORR identified ten pre-start findings that required corrective action plans (CAPs) and resolution before the CEF would be ready to commence critical assembly machine processes in accordance with the CEF Startup Plan.

The Chief of Defense Nuclear Safety (CDNS) conducted an NNSA biennial review of NSO May 9-18, 2011, to provide feedback to NNSA management on the safety of nuclear operations. As a result of the review, NSO received a grade of "Needs Improvement" in the criticality safety functional area. NSO conducted a management self-assessment (MSA) in preparation for the CDNS review that identified

¹ Shadowing is a specific type of oversight activity where HSS personnel observe a site office and/or contractor assessment and document HSS's evaluation of that assessment.

² The CEF was renamed the National Criticality Experiments Research Center on August 30, 2011, during the conduct of this assessment; however, CEF will continue to be used throughout this report.

significant deficiencies in the NSO criticality safety program definition and an inadequate level of oversight of the contractor criticality safety program. CAPs were issued that contained appropriate actions to correct the deficiencies identified. The biennial review concluded that the oversight processes and procedures did not ensure that an effective and fully compliant criticality safety program had been implemented at the site.

On May 11, 2011, NNSA approved the CEF Project Critical Decision (CD)-4 and the startup of nuclear operations at CEF. The *Planet* and *Comet* critical assembly startups were successfully completed in accordance with the approved Startup Plan. Preparations to start up the *Flat-Top* and *Godiva* critical assemblies were on track to proceed.

Based on the previously identified deficiencies in the criticality safety program for CEF and the approved startup of CEF as a new hazard category 2 nuclear facility, HSS increased its oversight of nuclear operations at CEF to determine the level of NSO and contractor compliance with criticality safety requirements.

3.0 SCOPE

The onsite review, conducted August 29 – September 2, 2011, included two separate small-team oversight activities combined into one visit and documented in this report: (1) shadowing of two line oversight functional area assessments of fissile material handling (FMH) in the CEF and for TACS operations, and (2) an appraisal of the CEF Startup Plan.

The criticality safety assessment shadowing included document reviews, attendance at NSO review team personnel interviews, and field observations. The independent review was conducted utilizing the approved NSO assessment plans and criteria and review approach documents (CRADs). NSO defined the criticality safety objectives as: LANL and LLNL have implemented a program that assures that FMH at CEF and for TACS operations, respectively, is in compliance with process evaluations for criticality safety, and that controls are implemented via procedures, postings, and engineered controls for FMH activities. The assessment plans also included appropriate criteria and lines of inquiry. NSO issued final contractor oversight assessment reports dated September 27, 2011. The results of these assessments are summarized in the next section and in Appendix A of this report.

The separate CEF Startup Plan appraisal included document reviews, personnel interviews, and field observations. This appraisal was conducted using the approved contractor Startup Plan, as well as criteria provided in the CEF Process Startup Checklist and CEF Oversight Evaluation Criteria. The Startup Plan provides a comprehensive schedule and overview of the startup process for the four critical assemblies, a description of the oversight process and requirements, a description of evaluation techniques for equipment operability, evaluation criteria for operator performance, and a description of the process for partial and full release of startup controls leading toward full, normal operations for CEF.

4.0 RESULTS

Criticality Safety Assessments

The planning, execution, and documentation of the two shadowed NSO functional area assessments of FMH in the CEF and for TACS operations satisfy the expectations of NSO O 226.XC, *Assessment and Oversight*. This NSO directive is the primary mechanism for implementing DOE Order 226.1 and NA-1 SD 226.1 to ensure that the contractor assurance system and NNSA/NSO assessment and oversight programs are comprehensive and integrated. Appendix A of this report provides a summary of significant issues identified during the NSO assessments, as well as Independent Oversight's observations related to

each issue. Further details about the NSO assessments and the identified issues are contained in the assessment final reports.

NSO developed adequate assessment plans for formal assessments scheduled on the Master Assessment Schedule approved by NSO senior management. The scope, review process (including objectives, criteria, and approach), and schedule were appropriate for these functional area assessments of criticality safety. An Independent Oversight observation related to the finding on criticality safety postings (see F-CS.1.6-1 in Appendix A) is that the assessment plans should have included infraction response in addition to postings and procedure compliance.

The conduct of the assessments by the NSO team was adequate. Document reviews were sufficient in depth, and field observations of several FMH activities provided sufficient overview of operations by LANL and LLNL personnel at CEF and for TACS operations, respectively, to determine that FMH processes are adequately implemented. Also, interviews with several personnel confirmed that they are sufficiently knowledgeable of requirements and responsibilities. The lead assessor of the NSO team was relatively new to his position as a criticality safety engineer and had limited assessment experience, but NSO senior management added a more experienced member to the team to ensure that NSO O 226.XC expectations were met. Overall, the assessment team performed well.

The final assessment reports provided sufficient documentation of the two assessments, including detailed results for each of the seven criteria reviewed for each assessment. Based on Independent Oversight's observations during the shadowing of both assessments, HSS personnel concur with the conclusions that the objectives of the CRADs were met, both for the CEF and for TACS operations. LANL and LLNL have implemented programs that assure FMH at CEF and for TACS operations, respectively, complies with process evaluations for criticality safety, and that controls are implemented via procedures, postings, or engineered controls for FMH activities.

The final report for the CEF criticality safety program identified three issues, which are listed in Appendix A. HSS personnel concur with the identified CEF issues and had a few additional observations, which are provided in Appendix A and summarized in Section 5. The final report for the TACS operations did not identify any issues and HSS personnel had no additional observations.

CEF Startup Plan Appraisal

HSS reviewed the CEF startup documents, interviewed the LANL N-2 Deputy Group Leader/CEF Project Leader and the Joint Nevada Project Office (JNPO) CEF Startup Manager, and made field observations of the CEF control rooms and criticality experiment assemblies. JNPO developed the CEF Startup Plan in accordance with NSTec requirements defined in CM-NOPS.001-006 and CD-NOPS.016. Based on Independent Oversight's assessment of the CEF startup activities to date, HSS concluded that the plan is adequate and that CEF personnel are knowledgeable of their responsibilities and are safely and effectively executing the plan.

The completed JNPO Forms F-083 and F-084 for the CEF material storage vaults and for the *Planet* and *Comet* critical assemblies provide sufficient documentation of the senior supervisory watch (SSW) post-evolution reviews and recommendations for removal of startup controls in accordance with the CEF Startup Plan. HSS personnel had some questions about how and when the SSW function would be terminated once all four critical assemblies are operational, but discussions with LANL personnel clarified that there is also an ORR commitment to maintain the SSW beyond CEF startup to ensure that management expectations for conduct of operations are met. This additional oversight is noteworthy.

HSS also questioned the updates to the documented safety analysis (DSA) and technical safety

requirements (TSRs) required for the subsequent *Flat-Top* and *Godiva* startups. Again, discussions with LANL personnel clarified that except for the two known DSA/TSR changes required for *Godiva* (i.e., assembly/disassembly of *Godiva* and fire suppression system isolation for burst operations), all changes are immediately effective upon NSO approval, regardless of when the DSA is subsequently updated.

5.0 CONCLUSIONS AND SUMMARY OF OBSERVATIONS

The HSS independent review concluded that the NSO functional area assessments of FMH in the CEF and for TACS operations were adequately performed in accordance with NSO O 226.XC expectations. The assessments properly concluded that both LANL and LLNL have implemented programs that assure FMH at CEF and for TACS operations, respectively, are in compliance with process evaluations for criticality safety, and that controls are implemented via procedures, postings, or engineered controls for FMH activities. HSS concurred with the identified issues but provided a few additional observations for NSO consideration as presented in Appendix A and summarized below:

- The LANL Criticality Safety Plan (CSP) description document should provide an explanation whenever an ANSI/ANS standard recommendation is not implemented.
- The assessment plans should have included infraction response in addition to postings and procedure compliance. Additionally, some postings for criticality safety are not in accordance with ANSI/ANS standards.
- Specific material storage locations should be explicitly identified before any material movements and not left to the discretion of the FMH personnel in the vault.

The HSS independent review also concluded that the CEF Startup Plan is adequate and that LANL personnel are safely and effectively implementing the plan. The *Planet* and *Comet* critical assemblies are operational and removed from startup controls. The *Flat-Top* and *Godiva* critical assemblies are on track for startup. The additional oversight to maintain the SSW beyond CEF startup to ensure that management expectations for conduct of operations are met is noteworthy.

6.0 ITEMS FOR FOLLOW-UP

Due to the elevated risk of the criticality safety functional area, the NSO *FY 2012 Assessment Implementation Plan* has a MSA of the NNSA/NSO Nuclear Criticality Safety Program scheduled for the 4th Quarter FY 2012. HSS intends to shadow this planned assessment as part of its increased oversight of nuclear operations at CEF.

Appendix A
Summary of Significant Issues

Significant Issue	Issues & Recommendations Discussed in Final Assessment Reports	Independent Oversight Observations
1	F-CS.1.1-1 The LANL CSP implementing crosswalk documentation does not fully demonstrate how the implementing documents from the home organization meet the NNSS NCSP requirements as required by CD-NOPS.001.	DOE Order 420.1B, Section III.3.b.(3) states "All recommendations in applicable ANSI/ANS standards must be considered, and an explanation provided to DOE through the CSP description document whenever a recommendation is not implemented." Justifications for exceptions to "should" statements in applicable ANS 8-series standards should be better documented in CD-NOPS.001, <i>Nuclear Criticality Safety Program</i> .
2	F-CS.1.6-1 The CEF criticality safety postings that were displayed on the High Bay building for firefighting guidance were inconsistent with CEF-PLA-014 and NCSR LIS 2009-002, which requires postings based upon criticality hazard present.	<p>Although the inherent risk of criticality at DAF/CEF is very low due to the nature of the deliberate processes involved, the assessment plans should have included infraction response in addition to postings and procedure compliance. Beyond assessing whether individuals are knowledgeable of their expectations and responsibilities for FMH activities, future CRAD criteria should also assess the individuals' knowledge of how to respond to any procedural criticality infractions.</p> <p>Also, some other postings for criticality safety are not in accordance with ANSI/ANS standards. For example, ANSI/ANS 8.7 requires that limits for storage be posted, and ANSI/ANS 8.19 requires specific limits to be posted as appropriate. However, the only postings within the storage vaults merely indicate that the material storage limits (i.e., the nuclear criticality safety limit approvals) are found in procedure CEF-SOP-011, <i>CEF MBA Operations Procedure</i>; those limits are not actually posted.</p>
3	OFI-CS.1.4-1 Material storage errors may be minimized by utilizing a more real time tracking database to maintain a map of the vault locations where each type of material configuration is allowed to be stored.	Specific storage locations should be explicitly identified prior to any material movements and not left to the discretion of the FMH personnel in the vault. For CEF to declare criticality to be incredible (i.e., risk of an accident is beyond extremely unlikely) requires that at least two independent means be used to control material movements and storage, and one of them could be Material Control and Accounting (MC&A) personnel independently verifying in advance that planned actions by FMH personnel will not result in an accident. Some recommended improvements were identified during prior assessments and should be further evaluated and implemented as practicable.

Appendix B Documents Reviewed

- DOE Order 420.1B, *Facility Safety*
- DOE-STD-1158-2010, *Self Assessment Standard for DOE Contractor Criticality Safety Programs*
- DOE-STD-3007-2007, *Guidelines for Preparing Criticality Safety Evaluations at Department of Energy Nonreactor Nuclear Facilities*
- ANSI/ANS-8.1-1998, *Nuclear Criticality Safety in Operations with Fissionable Material Outside Reactors*
- ANSI/ANS-8.19-2005, *Administrative Practices for Criticality Safety*
- ANSI/ANS-8.22-2006, *Nuclear Criticality Safety Based on Limiting and Controlling Moderators*
- NSO O 226.XC, *Assessment and Oversight*
- ASM-AMSS-3.28.2011-334815, *Criticality Safety Assessment Plan, LLNL TACS Operations*, August 2011
- Contractor Oversight Assessment Report ASM-AMSS-3.28.2011-334815, *Lawrence Livermore National Laboratory Fissile Material Handling of the Training Assembly for Criticality Safety*, September 2011
- ASM-AMSS-10.25.2010-295745, *Criticality Safety Assessment Plan, Criticality Experiments Facility*, August 2011
- Contractor Oversight Assessment Report ASM-AMSS-10.25.2010-295745, *Los Alamos National Laboratory CEF Criticality Safety Program*, September 2011
- CEF-TSR-01, *Criticality Experiments Facility Technical Safety Requirements*, Revision 1, Change Notice 3, December 3, 2010
- LLNL-MI-407120, *Device Assembly Facility Documented Safety Analysis Addendum for Criticality Experiments Facility Operations*, Revision 1 – Input for NSTec, Change Notice 3, December 3, 2010
- JNPO-PRO-105, *Joint Nevada Program Office (JNPO) Nuclear Criticality Safety Procedure*, Revision 0, November 30, 2009
- Los Alamos National Laboratory System Description No. SD-30, *Nuclear Criticality Program*, Revision 0, September 30, 2009
- UCRL-AM-133867, *LLNL Document 20.6 Criticality Safety*, Revision 7, March 26, 2009
- UCRL-AM-133867-VOL-1-PT-1.2-2009, *LLNL Document 1.2 ESH&Q Policies of LLNL*, Revision 8, January 21, 2011
- CD-NOPS.001, *Nuclear Criticality Safety Program*, Revision 2, August 10, 2010
- CD-NOPS.012, *Performance of Nuclear Criticality Safety Inspections or Walkthroughs and Responding to Conditions Adverse to NCS*, Revision 1, July 28, 2009
- CD-NOPS.016, *Developing the Startup Plan*, Revision 0, March 24, 2011
- CEF-PLA-013, *Startup Plan for the Criticality Experiments Facility*, Revision 5, May 11, 2011
- CEF-EXP-001, *Class Foils Criticality Demonstration Experiment Plan for Planet/Comet*, Revision 2, January 24, 2011

- CEF-EXP-002, *Comet Experiment Plan – Zeus*, Revision 3, January 24, 2011
- CEF-EXP-003, *Experiment Plan for Godiva*, Revision 5, January 24, 2011
- CEF-EXP-004, *Experiment Plan for Flat-Top*, Revision 3, January 24, 2011
- CEF-EXP-005, *Experiment Plan for Godiva Characterization*, Revision 0, January 24, 2011
- CEF-SOP-001, *Operating Procedure for the Comet Critical Assembly*, Revision 6, January 24, 2011
- CEF-SOP-002, *Operating Procedure for the Flat-Top Critical Assembly*, Revision 7, January 24, 2011
- CEF-SOP-003, *Operating Procedure for the Godiva Critical Assembly*, Revision 7, January 24, 2011
- CEF-SOP-004, *Operating Procedure for the Planet Critical Assembly*, Revision 6, January 24, 2011
- CEF-SOP-009, *Hand Stacking and Approach to Critical*, Revision 6, January 20, 2011
- CEF-SOP-011, *CEF MBA Operations Procedure*, Revision 7, May 31, 2011
- DAF-PRC-FA-14, *Operations Control (SBI)*, Revision 22, August 26, 2011
- *National Nuclear Security Administration Operational Readiness Review FINAL REPORT for the Criticality Experiments Facility*, July 2010
- JNPO Form F-083, *CEF Process Startup Checklist*, Revision 1, May 2011
- JNPO Form F-084, *CEF Oversight Evaluation Criteria*, Revision 1, May 2011
- Memorandum, Taylor to Baker, *N-Division Commitments for CEF Operational Readiness*, July 26, 2010

Appendix C Supplemental Information

Dates of Review

Onsite Review: August 29 – September 2, 2011

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