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<b>Criticality Safety Program and Criticality Safety Controls Implementation          Criteria and Review Approach Document</b>		
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## 1.0 PURPOSE

The mission of the U.S. Department of Energy (DOE) Office of Environment, Safety and Health Assessments (EA-30) is to assess the effectiveness of safety and emergency management systems and practices used by line and contractor organizations and to provide clear, concise, rigorous, and independent evaluation reports of performance in protecting workers, the public, and the environment from the hazards associated with DOE activities.

In addition to the general independent oversight requirements and responsibilities specified in DOE Order 227.1A, *Independent Oversight Program*, this criteria and review approach document (CRAD), in part, fulfills the responsibility assigned to the Office of Enterprise Assessments (EA) in DOE Order 226.1B, *Implementation of Department of Energy Oversight Policy* to conduct independent oversight and appraisals of high consequence activities. This CRAD specifically provides objectives, criteria, lines of inquiry, and review approaches to assess nuclear criticality safety programs under DOE Order 420.1C, *Facility Safety*, Attachment 2, Chapter III, “Nuclear Criticality Safety” at DOE sites.

The CRADs are available to DOE line and contractor assessment personnel to aid them in developing effective DOE oversight, contractor self-assessment, and corrective action processes. The current revision of EA’s CRADs are available at <http://www.energy.gov/ea/criteria-and-review-approach-documents>.

## 2.0 APPLICABILITY

The following CRAD is approved for use by EA-30 and sub-tier offices.

## 3.0 FEEDBACK

Comments and suggestions for improvements on this CRAD can be directed to the Director, Office of Environment, Safety and Health Assessments.

## 4.0 CRITERIA AND REVIEW APPROACH

The review of contractor criticality safety programs will evaluate the implementation and effectiveness of a DOE approved site criticality safety program (CSP) and associated criticality safety controls that ensure nuclear criticality safety is achieved by controlling one or more parameters of a system within subcritical limits including allowances for process contingencies. All engineered features (active and passive) and administrative controls may be considered during this review if they are being relied upon to prevent a criticality accident. These may or may not be identified as part of the Technical Safety Requirements (TSR). The following functional areas are designed as stand-alone sections to be used in any combination based on the need of the specific assessment. Although the criteria refer to standards and regulations, verify the applicability of those references for each site and/or facility.

The objectives and lines of inquiry are supported by the following regulations, orders, and standards (specific subsections are specified below in the objectives):

- 10 CFR 830, *Nuclear Safety Management*
- ANSI/ANS-8.1-2014 (R2018), *Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors*
- ANSI/ANS-8.3-1997 (R2007), *Criticality Accident Alarm System*
- ANSI/ANS-8.19-2014, *Administrative Practices for Nuclear Criticality Safety*
- ANSI/ANS-8.20-1991 (R2015), *Nuclear Criticality Safety Training*
- DOE Order 226.1B, *Implementation of Department of Energy Oversight Policy*
- DOE Order 227.1A, *Independent Oversight Program*
- DOE Order 420.1C, *Facility Safety*
- DOE-STD-3007-2017, *Preparing Criticality Safety Evaluations at DOE Nonreactor Nuclear Facilities*

### **OBJECTIVES**

**CS.1: Site contractor line management has established and implemented a criticality safety program (CSP) for nuclear facilities and activities, including materials transportation activities, which provide adequate protection to the public, workers, and the environment. (10 CFR Part 830.204 (b)(6); DOE O 420.1C, Attachment 2, Chapter III)**

#### **Criteria:**

1. The Site Contractor has prepared and submitted a CSP description document that has been approved by the Site Federal Office Manager or designee. The CSP description document is current and consistent with the commitments in the applicable documented safety analysis (DSA).

2. The Site Contractor has prepared implementing mechanisms for the CSP that meet the requirements of DOE O 420.1C and the commitments in each DSA and TSRs. Specifically, before a new operation is begun or before an existing operation is changed it shall be determined that the entire process will be sub-critical under both normal and credible abnormal conditions.
3. Procedures and mechanisms ensure that nuclear facility operations covered by the CSP are conducted in accordance with CSP requirements.
4. Issues identified during previous reviews have been appropriately resolved, corrective actions have been completed and are adequate, or a clear path to completion is indicated.

### Lines of Inquiry

- Has DOE approved the CSP Description Document?
- Does the Contractor have a written criticality safety policy?
- How is the criticality safety policy promulgated to employees?
- Are all fissionable material handlers and their supervisors familiar with the criticality safety policy?
- Are the roles and responsibilities of the Criticality Safety Engineers (CSEs) documented?
- Are the roles and responsibilities of the Nuclear Criticality Safety (NCS) Manager and Organization documented?
- Are the roles and responsibilities of the Criticality Safety Officers (CSOs) documented, if applicable?
- Is there a clear distinction between the roles of the CSO and the CSE?
- Is line management assigned responsibility for criticality safety?
- Is the Contractor NCS Staff administratively independent of operations?
- Has management established a qualification program for the criticality safety staff?
- Is the backlog of criticality safety evaluations excessive?
- Are criticality safety related performance metrics in place and used by management to monitor the effectiveness of the program?
- Are all deficiencies related to criticality safety entered in a corrective action tracking system?
- Are mechanisms in place to validate closure of all criticality safety related deficiencies?
- Does management maintain awareness of criticality safety deficiencies using a corrective action tracking system?
- Is there a program or procedure for trending deficiencies in the criticality safety program?
- Does the Contractor perform assessments of compliance to operating procedures?
- Does management routinely and adequately audit operations for compliance to criticality safety requirements?

**CS.2: Criticality safety evaluations are appropriately developed and demonstrate that entire processes involving fissionable materials will remain subcritical under normal and credible abnormal conditions, including those initiated by design basis events. (DOE O 420.1C, Attachment 2, Chapter III, Nuclear Criticality Safety, 3(d)&3(f); 10 CFR 830.204(b)(6))**

### **Criteria:**

1. Criticality safety evaluations demonstrate sound engineering/scientific principles (e.g., defense in depth, conservative design margins, human factors engineering) and appropriate standards, including the American National Standards Institute/American Nuclear Society (ANSI/ANS) Series 8 Standards, as applicable, in helping to craft criticality safety controls. [DOE 420.1C, Chapter III, 3(d); ANSI/ANS 8.1, 4.2; DOE-STD-3007- 2017, 3.4 and 3.5.]

2. Technical, functional, and performance requirements for criticality safety controls are specified in criticality safety documents. These documents identify and describe the safety functions and are effectively translated into procedures and workspace postings. [DOE 420.1C, Chapter III, 3(d); ANSI/ANS 8.1., 4.1.3 and 4.1.4; ANSI/ANS 8.19, 7.2, 7.3, 8.5.2, and 8.5.4; and DOE-STD-3007-2017, 3.6]
3. Criticality safety evaluations demonstrate that criticality safety controls are robust and meet the double contingency principle (sufficient factors of safety are incorporated into process designs so that at least two unlikely, independent, and concurrent changes in process conditions are necessary before a criticality accident is possible) and process analysis expectations. DOE is made aware of operational conditions where double contingency or process analysis expectations are not satisfied, and DOE acceptance is obtained consistent with approved CSP expectations. [DOE 420.1C, Chapter III, 3(d); ANSI/ANS 8.1, 4.1.1 and 4.2.2 and ANSI/ANS 8.19, 4.2]
4. The effects of changes to criticality safety requirements or conditions to which they apply are reviewed and understood before the start of operations. [DOE 420.1C, Chapter III, 3(d) and ANSI/ANS 8.19, 7.2 and 7.4]
5. Criticality safety evaluations are conducted in accordance with DOE-STD-3007-2017, *Preparing Criticality Safety Evaluations at DOE Nonreactor Nuclear Facilities*, or by other documented methods approved by the DOE Head of Field Element. [DOE 420.1C, Chapter III, 3(d)]

#### Lines of Inquiry

- Within the scope of the review, do the criticality safety evaluations provide the basis for safety requirements and functions of selected criticality safety controls, which is consistent with the logic and assumptions presented?
- Do the criticality safety evaluations identify the appropriate performance criteria necessary to provide reasonable assurance that selected criticality safety control functional requirements will be met?
- Do the criticality safety evaluations identify and describe the selected criticality safety control safety functions?
- Do the criticality safety evaluations for selected criticality safety controls appropriately reflect assumptions of facility configuration and human performance of safety functions, operational parameters, and key programmatic elements?

#### **CS.3: Criticality safety controls are effectively implemented, in accordance with the requirements of the ANSI/ANS-8 series of nuclear criticality safety using documented and approved processes. (DOE 420.1C, Chapter III, 3(e); 10 CFR 830.204(b)(6))**

1. Management organizational structures and systems provide assurance that criticality safety controls are implemented and are being maintained such that they will fully and reliably perform their safety functions over the life of the facility. [ANSI/ANS 8.1, 4.1.1, 4.1.5 and 4.1.6; ANSI/ANS 8.19, 4.6, 4.7, and 4.8]
2. Criticality safety controls and how they are implemented are adequately communicated to workers via training, statements in procedures, workplace postings and other operator aids as appropriate. The need for materials labeling and other identifiers used to prevent criticality is understood and are adequate, i.e., workers may readily verify limit compliance. [ANSI/ANS 8.1, 4.1.1, 4.1.3 and 4.1.4; ANSI/ANS 8.19, 5.3, 8.5.4, and 8.9; ANSI/ANS 8.20, 6.1 and 6.2]
3. Non-adherences to controls are investigated, corrected, and documented. Additionally, cases where controls are discovered to be confusing or inadequately understood are resolved whether an actual non-adherence occurs. [ANSI/ANS 8.19, 8.7]

4. Operations shall be reviewed frequently (at least annually) to ascertain that procedures are being followed and that process conditions have not been altered to affect the criticality safety evaluation assumptions [ANSI/ANS 8.19, 8.6 and 8.6.1]
5. Support activities (e.g., non-destructive assay and firefighting) are adequately controlled, and involved personnel are aware of the potential consequences due to erroneous data or actions. [DOE 420.1C, Chapter III, 3(g) ; ANSI/ANS 8.1, 4.1.1 and ANSI/ANS 8.19, 8.5.4]
6. Facilities that conduct operations using fissionable material in a form that could inadvertently accumulate in significant quantities must include procedures for detecting and characterizing accumulations. [DOE 420.1C, Chapter III, 3(e)]
7. Planned response to criticality accidents is adequate and evacuation drills and other activities verify workers understand and can execute their responsibilities during a response to a criticality alarm. Accidental alarms and miscommunications are minimized. [ANSI/ANS 8.1, 4.1.1 and 4.1.7; ANSI/ANS 8.3, 4.4.1, 4.4.2, 5.4, 6.1, 6.2, and 6.4 – 6.7; ANSI/ANS 8.19, 5.3 and ANSI/ANS 8.20, 7.4.1]

#### Lines of Inquiry

- Are operations personnel knowledgeable, trained, and able to satisfactorily perform or respond to operational, abnormal response, and emergency procedures for selected criticality safety controls, as applicable, including responses to criticality accident alarms?
- Are support personnel knowledgeable, trained, and able to satisfactorily perform their respective duties regarding selected criticality safety controls and emergency response, as applicable?
- Is access to work areas controlled such that personnel who are not sufficiently trained will be assisted in the event of an emergency and are prevented from causing an infraction or emergency?
- Do the respective procedures and postings cite applicable criticality safety requirements in user-friendly terms?
- Are limits, precautions, system prerequisite conditions, data required, acceptance criteria, and independent verification elements included in the respective procedures for criticality safety controls?
- Are appropriate data recording provisions included or referenced and used to record operational data?
- Do the respective procedures include provisions for listing discrepancies?
- Do the respective procedures require timely notification to facility management about any discrepancy that could impact performance of selected criticality safety controls?
- Do appropriate personnel (e.g., operations, criticality safety engineers, criticality safety officers, etc.) review such results and take appropriate action?
- Are responses to deviations, infractions, and violations of criticality safety controls adequate? Is the frequency of such events reasonably minimal? Does management stress positive reinforcement, i.e., so that personnel are not reluctant to self-report?
- Are analyses and corrective actions, including schedules for completion, designed to prevent or minimize repeat infractions or lesser deviations of selected controls reasonable, i.e., demonstrate a graded approach to safety and reflect due diligence?
- Is timely closeout of infraction corrective action(s) the norm? Are completion date extensions reasonable?
- Is there sufficient coordination among various contractor internal organizations regarding implementing selected controls and verifying that their underlying assumptions remain valid (e.g., nondestructive assay (NDA) results are reviewed and utilized in evaluation of continued adequacy of mass assumptions in criticality safety evaluations)?

- Are criticality accident alarm systems functional and do workers understand what to do if an alarm occurs?
- Do evacuation drills, i.e., plans, critiques, and other associated documents, indicate adequate compliance with requirements regarding (simulated) emergency conditions?
- Review records of false alarms and means to prevent them.
- Have rigorous assessments of criticality safety control developmental processes and their implementation, including simulated responses to emergencies, been performed by the contractor and DOE site office and appropriate corrective actions implemented, where appropriate? Do contractor self-assessments adequately evaluate the implementation of the selected controls (e.g., refer to DOE-STD-1158 (archived), Self-Assessment Standard for DOE Contractor Criticality Safety Programs)?

## ***REVIEW APPROACH***

### Record Review:

- Criticality Safety Program Document
- Criticality Safety Program Implementing Documents
- Documented Safety Analysis
- Technical Safety Requirements
- Nuclear Criticality Safety Evaluations
- Fissile Material Operations Procedures
- Criticality Safety Postings
- Training materials on how and why to comply with the selected criticality safety controls, including how to determine values of items being controlled and how to operate and calibrate systems that give alarms or other useful indications when limits are exceeded, and a sample of the respective training records, including measures to ensure that certified fissionable materials handlers perform work with fissionable materials and associated systems, equipment, and materials.
- Records relating to infractions or violations of selected criticality safety controls, any trends, NDA results, and resultant analyses and corrective actions designed to prevent or minimize repeat infractions. Additionally, review records relating to lesser deviations of these controls that may indicate insufficient diligence.
- Contractor assessment activity schedules and assessment results for independent, management, and other self-assessments and external reviews/inspections (including DOE site office) of implementation for the selected controls.

### Interviews:

- Criticality Safety Management
- Criticality Safety Staff
- Criticality Safety Officer
- Facility Management
- Facility Safety
- Operations Personnel
- Maintenance Supervisors
- Maintenance Personnel
- Design Engineers
- Configuration Management SME
- NDA Personnel

Observations:

- Verify, by walkdown or other means that installed instrumentation and control and support equipment required to ensure ongoing implementation of selected criticality safety controls and proper emergency responses will function under credible accident/event conditions.
- Fissile Material Operations
- Fissile Material Staging Operations (vaults, etc.)
- TSR Surveillance of Criticality Safety related SSC's
- Walk-through of the fissile material operating procedures implementing the criticality safety controls
- Activities in support organizations (e.g., Chemistry Laboratory, MC&A, and NDA).
- Normal maintenance activities on SSC's associated with fissile material fissile material.