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DOE STANDARD

SELF-ASSESSMENT STANDARD FOR DOE CONTRACTOR CRITICALITY SAFETY PROGRAMS

U.S. Department of Energy
Washington, D.C. 20585

AREA SAFT

FOREWARD

1. This Department of Energy standard is approved for use by all DOE Components and their contractors.

2. Beneficial comments (recommendations, additions, deletions) and any pertinent data that may improve this document should be sent to the Office of Special Projects and Investigations (EH-21), U.S. Department of Energy, Washington, D.C. 20585, by letter, or by using the self-addressed Document Improvement Proposal (DOE F 1300.3) appearing at the end of this document.

3. DOE Technical Standards, such as this standard, do not establish requirements. However, all or part of the provisions in a DOE standard can become requirements under the following circumstances:

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   (b) the organization makes a commitment to meet a standard in a contract or in an implementation plan or program plan required by a DOE requirements document.

Throughout this standard, the word "shall" is used to denote actions which must be performed if the objectives of this standard are to be met. If the provisions in this standard are made requirements through one of the two ways discussed above, then the "shall" statements would become requirements. It is not appropriate to consider that "should" statements would automatically be converted to "shall" statements as this action would violate the consensus process used to approve this standard.

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SELF-ASSESSMENT STANDARD FOR DOE CONTRACTOR CRITICALITY SAFETY PROGRAMS

PURPOSE

The purpose of this document is to provide an assessment tool for review of DOE Contractor criticality safety programs. Assessment of elements as indicated in this Standard will evaluate whether the program meets the requirements of ANSI/ANS-8.19-1996, *Administrative Practices for Nuclear Criticality Safety*, as well as related ANSI/ANS-8 series standards. These standards represent the best practices for criticality safety programs.

SCOPE

This document encompasses all elements of the Contractor criticality safety program at DOE facilities. The effectiveness of the criticality safety program is dependent upon management implementing its roles and responsibilities to integrate criticality safety into work practices as stated below:

An effective nuclear criticality safety program includes cooperation among management, supervision, and the criticality safety staff; for each employee, the program relies upon conformance with operating procedures. (Introduction to ANSI/ANS-8.19-1996)

In May of 1997 the Defense Nuclear Facilities Safety Board (Board) issued Recommendation 97-2 dealing with criticality safety. Among the nine specific recommendations made were: 1) the need for DOE Sites to maintain a formally trained and qualified nuclear criticality safety staff including hands on experience at critical mass laboratories; 2) the use of simplified bounding methods of setting subcritical limits with priority given to existing experimental data; 3) line management ownership of criticality safety; and, 4) the formation of a core group of criticality safety experts available to assist the DOE with criticality safety related issues.

This self-assessment tool was first developed as part of the Department's Criticality Safety Self-Improvement Initiative. The guidance was introduced and distributed at the Criticality Safety Self-Improvement Workshop, "Your Mission and Nuclear Criticality Safety," held in Las Vegas, Nevada in August 1999. The Department's Criticality Safety Support Group reviewed and

endorsed this self-assessment tool prior to the August 1999 Workshop. The Deputy Secretary of Energy subsequently required all DOE sites to self-assess their criticality safety programs using these criteria in response to the Tokai-Mura criticality accident.

The applicable DOE Order for criticality safety is DOE Order 420.1. It requires compliance with certain ANSI/ANS Standards for criticality safety. The assessment areas presented in this plan were drawn from the mandatory Standard, ANSI/ANS-8.19-1996, *Administrative Practices for Nuclear Criticality Safety*, and are categorized as follows:

- Management Responsibilities - Management demonstrates ownership and participation in the criticality safety program; authorities and responsibilities are defined, understood and implemented; management provides a nuclear criticality safety staff that is competent in the physics of criticality and associated safety practices as well as familiar with fissile material operations; management ensures that the nuclear criticality safety staff is independent of line management to the extent practicable; management assigns responsibility for criticality safety in a manner consistent with other safety disciplines; and, management establishes means of monitoring the criticality safety program and obtains feedback on the overall effectiveness of the program.

- Supervisory Responsibilities - Line supervision accepts responsibility for the criticality safety of their operations; supervisors understand the controls, contingencies, and criticality safety basis for operations under their control; classroom and job-specific training in criticality safety is provided to personnel; procedures govern all work and there are effective change control and configuration control mechanisms; supervisors verify compliance with criticality safety specifications before authorizing work; and supervisors require conformance with good safety practices, good housekeeping, and unambiguous identification of fissile materials.

- Nuclear Criticality Safety Staff Responsibilities - The nuclear criticality safety staff is comprised of specialists skilled in the techniques of nuclear criticality safety assessment and familiar with plant operations while, to the extent practicable, administratively independent of line management; the staff provides technical guidance for design of equipment, processes, and procedures; the staff reviews modifications to equipment, process, and procedures involving fissile material; the staff maintains familiarity with criticality codes, guides,

standards, and best practices; the staff is interactive, both internally and externally having access to criticality safety professionals to provide assistance as needed; the staff understands the physics of criticality and makes use of experimental data, handbook data, and bounding methods where applicable; the staff participates in training personnel; the staff participates in audits of operations; and the staff examines reports of procedural violations and criticality infractions and recommends improvements in safety practices to management.

- Operating Procedures - Procedures are written and organized to facilitate operator use and understanding; procedures contain criticality controls; mechanisms are in place to facilitate revising and improving procedures on a periodic basis; new or revised procedures involving fissile material are reviewed by the nuclear criticality safety staff; procedures are supplemented by postings; postings are easily visible, understood by operators and contain clear, and contain all criticality controls implemented by the operator; deviations from procedures and processes and criticality infractions are investigated promptly, documented, reported to management, categorized according to approved procedures, and actions are identified to prevent recurrence; criticality infractions are resolved in a timely manner; and, operations are reviewed frequently (at least annually) to assure that processes and procedures have not been altered in a way so as to affect the applicable nuclear criticality safety evaluation. The objectives of this section are met, in part, by nuclear criticality safety staff maintaining familiarity with day-to-day process operations through activities such as attendance at Plan-of-the-Day meetings, pre-evolution briefings, on-the-floor presence at the operations site, participating in regular audits, etc.

- Process Evaluation for Nuclear Criticality Safety - All fissile material operations are analyzed to show that the processes will remain subcritical under all normal and credible abnormal conditions; the criticality safety evaluation is documented in a clear unambiguous manner; contingencies and controls are explicitly identified; calculational methods are properly validated; priority is placed on experimental data, handbook values, and bounding methods where applicable; engineered safety features are relied on to provide criticality safety to the extent practicable; procedures for producing criticality safety evaluations, limits, and postings are used; and criticality safety evaluations are independently peer reviewed before operations are authorized.

- Materials Control - Movement of fissile materials is controlled; fissile material is labeled including mass, chemical form, and isotopic composition; storage areas are posted with applicable criticality safety limits; methods are established to monitor the presence and effectiveness of credited neutron absorbers; access to fissile material handling areas is controlled and fissile material handler qualification verified; and, control of spacing, mass, density and geometry of fissile material is maintained to assure subcriticality under all normal and credible abnormal conditions.

- Planned Response to Nuclear Criticality Accidents - Criticality accident detectors are capable of detecting the minimum accident of concern; the criticality accident alarm system (CAAS) is designed in such a way as to minimize false alarms; detector placement criteria for all permanent and temporary detectors is documented; a configuration management system is in place to assure the ongoing functionality of the CAAS; the CAAS can alarm all areas of the facility by either audible or visible means; emergency response procedures for criticality accidents are in place; personnel are trained in evacuation procedures; evacuation routes and assembly points are identified; procedures for accounting for personnel are in place; criticality accident drills are conducted at least annually and are as realistic as practicable; advance arrangements are in place for the treatment of exposed and contaminated individuals; radiation monitoring equipment is available to response personnel; radiation monitoring personnel are trained; and, emergency procedures address re-entry of facilities and the membership of re-entry teams.

ASSESSMENT REQUIREMENTS

Each of the following criteria and associated lines of inquiry should be covered in a facility assessment activity at least once during a predetermined period. Experience has shown that an acceptable interval for self-assessing the criticality safety program, including all the material in this standard as it applies to a facility, is once every three years. This suggested interval may be adjusted to meet specific site/facility needs. The Assessor should establish appropriate lines of inquiry and may use the ones suggested below or may generate his/her own for a given assessment activity. While these lines of inquiry may be used verbatim, tailoring them to site-specific applications and language is encouraged. Lines of inquiry that do not apply to a given facility should not be used. Finally, proper use of this self-assessment standard requires knowledgeable (i.e. in criticality safety and safety management) personnel performing extensive

tours of facilities, interviews of personnel, reviews of documentation, and observations of work practices. Important safety issues may be missed entirely if assessments are limited to paperwork reviews only. Criticality safety related ORPS data, including conduct of operations occurrences potentially affecting criticality safety, are relevant to such reviews and should be utilized.

In each of the sections that follows, specific lines of inquiry are presented for each of the major criterion sections of ANSI/ANS-8.19-1996. These are keyed to the ANSI Standard by topic heading and subsection number within the Standard itself.

1.0 MANAGEMENT RESPONSIBILITIES

Criteria: Section 4.1, Responsibility for Safety

- Does the Contractor Facility Management demonstrate continuing interest in criticality safety as evidenced by conducting safety meetings, issuing safety bulletins, inspecting facilities on a regular basis, and ensuring continuous improvement in safety?
- Does the Contractor Facility Management demonstrate continuing interest in criticality safety as evidenced by regular meetings with the criticality safety engineers and the Nuclear Criticality Safety (NCS) manager?
- Does the Contractor Program Management regularly meet with the NCS manager?

Criteria: Section 4.2, Criticality Safety Policy

- Does the Contractor have a written criticality safety policy?
- Are all fissile material handlers and their supervisors familiar with the criticality safety policy?
- How is compliance to the Contractor criticality safety policy required of all program personnel performing work?

Criteria: Section 4.3, Responsibility for Implementing Policy

- Are the roles and responsibilities of the Criticality Safety Engineers (CSEs) documented?
- Are the roles and responsibilities of the 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?
- Has the Contractor assigned responsibility for oversight of the NCS program?

Criteria: Section 4.4, Criticality Safety Staff Independent of Operations

- Does the Contractor have sufficient funding to assure continuous support by NCS Staff?
- Does the Contractor management provide discretionary funding to the NCS manager to provide training and professional development for the NCS staff, to address laboratory wide issues, to maintain the NCS program documentation, and to ensure that criticality safety codes and platforms are verified and validated?
- Does the NCS Staff have unilateral, unscheduled access to the facility and operations personnel?

- Does the Contractor have a plan or policy to assure the NCS Staff is familiar with fissile operations? Does the Contractor issue requirements for the qualification and training of NCS Staff, including subcontractors?
- Is the Contractor NCS Staff administratively independent of operations?
- Do all members of the NCS Staff have technical degrees in physics or nuclear engineering or another technical degree judged appropriate by NCS management?

Criteria: Section 4.5, Monitoring the Criticality Safety Program

- Who is responsible for monitoring the criticality safety program?
- Are criticality safety related performance metrics in place and used by management to monitor the effectiveness of the program?
- Do the criticality safety performance metrics encourage self-reporting of deficiencies and continuous improvement?
- Do the criticality safety performance metrics promote practices that prevent repeat criticality safety infractions of the same type or for the same operation/process?
- Are the criticality safety performance metrics measurable and objective?
- Do the criticality safety performance metrics encourage development of a strong staff and program by measuring performance in the training and qualification program of nuclear criticality safety staff, professional development, participation in the American Nuclear Society Nuclear Criticality Safety Division, preparation of technical papers, etc.?
- 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 line program management maintain awareness of criticality safety deficiencies through the use of 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 the Contractor assess implementation of conduct of operations?
- How are NCS funding levels proposed and approved?
- How does the Contractor management determine that funding for NCS is sufficient and is there a mechanism for adjusting the funding during the fiscal year?

Criteria: Section 4.6, Participation in Audits

- Does the Contractor management participate in review teams or committees to assess facility criticality safety programs?
- Does the Contractor program management routinely audit operations for compliance to criticality safety requirements?
- Does the Contractor facility management routinely audit operations for compliance to criticality safety requirements?
- Does the Contractor perform NCS management self-assessments of their criticality safety staff and program?

Criteria: Section 4.7, Nuclear Criticality Safety Committees

- Does management utilize a nuclear criticality safety committee to assist in monitoring and improving the criticality safety program?
- If nuclear criticality safety committees are used, do they report directly to the Senior Management? Are the findings from the nuclear criticality safety committee, or equivalent, entered into a tracking database and corrective actions implemented?
- Are outside consultants utilized to provide an independent viewpoint on the overall criticality safety program?

2.0 SUPERVISORY RESPONSIBILITIES

Criteria: Section 5.1, Responsibility for Safe Operations

- Do line program supervisors accept responsibility for criticality safety of their operations? Is ownership demonstrated by the following: 1) approving criticality safety postings; 2) reviewing and approving criticality controls in procedures; 3) participating in the development of criticality safety evaluations; 4) participating in the development of credible process upsets for the NCS staff to consider; and 5) approving criticality safety evaluations for operations?
- Do line supervisors ensure that operators participate in the development of criticality safety evaluations, identification of credible process upsets, limits, and controls including identification of engineered controls?

Criteria: Section 5.2, Knowledge of Criticality Safety

- Does line program supervisors formally review credible process upsets and criticality accident scenarios analyzed by the NCS staff during development of the CSE?
- Do line supervisors and operators under their supervision identify practical engineered controls that can be implemented in lieu of administrative controls during the preparation and/or review of criticality safety evaluations and limits?
- Do line program supervisors understand the underlying assumptions in CSEs which involve configuration of equipment, facility modifications, isotopic composition, etc.?
- Is the Nuclear Criticality Safety Staff requested to provide NCS training to line program supervisors?
- Does line program supervision know the safety basis for the criticality controls for their operations?
- Does the NCS staff provide advice and assistance to line program management regarding implementation of NCS controls?

Criteria: Section 5.3, Operator Training

At a minimum, operators receive criticality safety training in accordance with ANSI/ANS-8.20, “Nuclear Criticality Safety Training.”

- Do supervisors provide job specific training on procedures?
- Are walkthroughs and dry-runs on procedures provided?
- Do pre-job briefs cover criticality controls specific to the operations at hand?
- Do plan-of-the-day meetings address criticality safety related topics like work restrictions due to criticality safety infractions, availability of new procedures and postings, need for NCS Staff participation, results of recent criticality safety assessments/surveillances, etc?
- Do supervisors maintain training records for their personnel?
- Do supervisors ensure that their personnel are current in criticality safety classroom training?
- Are there required reading records or other evidence that personnel are knowledgeable of changes to procedures, and criticality safety postings?
- Can supervisors and operators answer questions about the basic criticality controls for their operations?
- Can supervisors generally describe the contingencies and controls for the contingencies for their operations including credited engineered features and key facility assumptions, if any?
- Do supervisors ensure that personnel have demonstrated an understanding of modified or revised procedures, and criticality safety postings prior to authorizing work?
- Are there records of job specific training on procedures and criticality safety postings?
- Do supervisors request assistance from the Nuclear Criticality Safety Staff to provide training for operations personnel?

- Do firefighters receive criticality safety training?
- Are firefighters aware of any moderator-controlled areas or processes?
- Are firefighters made aware of locations where a mist condition could affect criticality safety?

Criteria: Section 5.4, Operating Procedures

- Are all fissile material handling operations performed according to approved procedures?
- Are operations personnel or supervision involved in developing procedures?
- Is there a mechanism to assure that only current, approved procedures, CSEs, and postings are used for operations?
- How does the line program supervisor know when to authorize work after all NCS requirements have been met after modifications to the existing set of controls/procedures?
- Does a clear, unambiguous link between the CSE, procedure and posting exist such that it is traceable from floor level documentation?
- Is there a mechanism to ensure that OSR related controls and requirements in procedures or postings are not changed without proper analysis and approval?
- Are Unreviewed Safety Question Determinations (USQD) performed for all procedure modifications?

Criteria: Section 5.5, Maintaining Compliance with Requirements

- Are there procedures or mechanisms in place and effective to ensure that modifications to equipment and/or processes results in a review of the applicable CSEs-procedure-posting set prior to implementing the modification?
- Are there documented surveillances or methods that ensure that new or modified operations conform to applicable CSEs-procedures-postings?
- Is there a process for ensuring that no new or modified operation is started until all applicable verification steps have been performed which includes presence of approved CSEs, postings, procedures and that no criticality infraction will result from startup?
- Are appropriate surveillance frequencies established for engineered controls relied upon for criticality safety to ensure that the controls are performing their intended function?

Criteria: Section 5.6, Labeling and Good Housekeeping Practices

- Are stored, empty containers labeled as such where there could be uncertainty as to whether or not containers are empty?
- Are gloveboxes with criticality drains free of loose debris, which could potentially clog the drain?
- Is fissile material stored in approved containers?
- Prior to beginning work at a workstation, is there a procedure to verify compliance with criticality safety requirements?
- Is there evidence of fissile material holdup or filings in gloveboxes?
- Are criticality drain liquid traps monitored for adequate liquid levels periodically?

3.0 NUCLEAR CRITICALITY SAFETY STAFF RESPONSIBILITIES

Criteria: Section 6.1, Technical Guidance for Design of Equipment and Processes

- Does the NCS Staff provide design input for all new or modified equipment?
- Does the NCS Staff review all operating procedures involving fissile materials?
- Does the NCS Staff review and concur on final equipment and process designs?

Criteria: Section 6.2, Required Knowledge and Capability

- Do all members of the Nuclear Criticality Safety Staff understand and know how to properly utilize monte carlo codes (e.g. KENO and MCNP), criticality safety handbooks, critical experiment data, hand-calculations, etc.?
- Does the Nuclear Criticality Safety Staff maintain verified and validated computational techniques for performing criticality safety evaluations for the site?
- Does the Contractor NCS Staff participate in professional development activities such as ANS Standards Committees, Nuclear Criticality Technology Project Workshop, ANS Meetings, LANL/LACEF courses, UNM courses, etc.?
- Is there a training and qualification program for the Contractor NCS Staff? Are all the members of the Contractor NCS Staff qualified?
- Does the NCS Staff have working knowledge of criticality safety related standards, guides, and codes?

Criteria: Section 6.3, Consulting with Knowledgeable Individuals

- Does a synergistic interaction exist among the NCS Staff assigned to specific facilities and the remainder of the Contractor NCS staff?
- Does the NCS Staff consult with offsite criticality safety experts periodically, particularly retirees from the facility?

Criteria: Section 6.4, Familiarity with Operations

- Does the NCS staff observe fissile material handling and processing operations?
- Are members of the NCS Staff knowledgeable of credible abnormal process upsets applicable to facility operations?
- Does the NCS Staff attend operations planning meetings for new or restarted processes?
- Does the NCS Staff have access to and familiarity with fissile material operating procedures?
- Does the NCS Staff attend pre-job briefs and plan-of-the-day meetings?
- Does the NCS Staff maintain familiarity with reports of deviations from expected process conditions even if these deviations do not result in a criticality infraction?

Criteria: Section 6.5, Assistance with Operator Training

- Does the NCS Staff participate in training personnel?
- Is the training documented?
- Does the training provided by the NCS Staff include job specific criticality safety related information?

Criteria: Section 6.6, Audits

- Does the NCS Staff participate in periodic audits of operations and procedures?
- Are the results of audits shared among the NCS Staff?
- Are the results of audits reported to appropriate Facility Management?
- Are corrective actions developed for deficiencies?

Criteria: Section 6.7, Investigation of Criticality Safety Violations and Deficiencies

- Are nonconformances with criticality safety requirements reported to and reviewed by the NCS Staff?
- Does the NCS Staff formally report findings and recommendations to Facility Management?
- Are lessons learned developed and recommendations to prevent recurrence made to Facility management?

- Are all criticality safety related deficiencies captured in a database and tracked until closure is verified?
- Is there a mechanism for trending criticality safety related deficiencies so that the collective significance of multiple minor incidents can be assessed and corrected?
- Are lessons learned from other facilities reviewed by the NCS Staff for potential application at the facilities?

4.0 OPERATING PROCEDURES

Criteria: Section 7.1, User-Friendly Procedures

- Are criticality controls in procedures clear, concise, free of criticality safety jargon, and easily identifiable?
- Is the criticality safety related information presented in procedures free of unnecessary detail and directly applicable to the job task being performed?
- Do the operators find the criticality safety related instructions easy to understand and follow?

Criteria: Section 7.2, Criticality Controls

- Are criticality controls included in operating procedures?
- Are the criticality controls clearly identified as important to safety?
- Is there a clear, unambiguous, link between criticality controls in procedures and postings and their parent CSE?
- Does the Contractor have a formalized process for determining which controls are incorporated in procedures?
- Do pre-fire plans incorporate criticality safety controls?
- Are firefighters trained and familiar with applicable criticality safety controls and practices?
- Does the NCS staff review and provide specific input to safety assessments/evaluations of other hazards that may involve criticality safety concerns?
- Are criticality related instructions in pre-fire plans and firefighting procedures practical under actual conditions of responding to fires?

Criteria: Section 7.3, Maintaining Current Procedures

- Are procedures revised based on lessons learned to reduce occurrence of deviations and infractions?
- Do operators have a feedback process whereby improvements to procedures can be implemented?
- Are adequate resources available to facilitate procedure improvements as they are identified?
- Are procedure revisions timely?
- What change control mechanism is in place that assures only the current, approved procedures are utilized?

Criteria: Section 7.4, Periodic Procedure Review

- Are procedures periodically reviewed?
- Does the NCS Staff periodically participate in reviews of active operating procedures?
- What mechanisms are in place to ensure that all procedures are reviewed as planned?

Criteria: Section 7.5, Nuclear Criticality Safety Staff Review

- Do new or revised procedures receive review by the NCS Staff?
- Is there a mechanism for resolving conflicting comments the NCS Staff and the other reviewers?

Criteria: Section 7.6, Criticality Safety Postings

- Are criticality safety postings easy to understand by operators?
- Do the postings contain only information controlled by the operator performing the task?
- Do the postings require any analysis on the part of the operator such as decoding “IF-THEN”, “EITHER-OR” type options to select appropriate controls?
- What is the relationship between the controls in the posting and the controls in the procedures?
- Is there a formalized process for determining which controls appear on postings and which appear in procedures?
- What mechanism is in place to ensure that the controls in the posting are consistent with those intended by the parent CSE?
- Are postings easy to read from normal operator positions at the workstation?
- Do operators rely primarily on postings to obtain their criticality safety controls?
- Are all the controls necessary for criticality safety included in postings? If not, are the operators trained on how to find all the controls applicable to the process?
- Is it possible to comply with the requirements of the posting and still incur a criticality safety infraction because additional controls are contained in the procedures? If so, is there a process for directing operators to the complete set of required controls?

Criteria: Section 7.7, Response to Criticality Safety Infractions/Violations/Deficiencies

- How are infractions graded?
- Are the contingencies and barriers for a given operation readily available to the NCS Staff investigating potential infractions?
- Do procedures exist to upgrade the assigned severity level of infractions due to adverse trends?
- Do procedures exist to upgrade the assigned severity level of infractions due to the magnitude of the decrease in the margin of subcriticality?
- Do operators immediately stop work, leave the immediate vicinity, notify supervision, post the area, and contact the NCS Staff promptly when a potential infraction is identified?
- Does the NCS Staff respond to the scene of a potential infraction?
- Are the responsibilities defined for responding to a potential infraction?
- Does the NCS Staff participate in management critiques of infractions, assigning levels of infraction, and developing corrective actions?
- Are infractions resolved promptly and normal operations restarted?
- When the NCS Staff recommends immediate corrective actions to recover from an infraction, are these recommendations made in writing, peer reviewed, and approved by line (Facility or Program) management?
- Are corrective actions stemming from criticality infractions entered into a tracking database and monitored until closure?
- Are minor criticality infractions tracked and trended?
- Are all criticality infractions, regardless of severity, documented?

Criteria: Section 7.8, Annual Operations Reviews

- Are all operations reviewed at least annually?
- How do annual reviews determine that procedures are being followed?
- Do audits and reviews monitor the configuration of the facility and processes which could adversely affect criticality safety, such as movements of criticality detectors, installation of new equipment, inoperable emergency enunciators, etc.?

- Do personnel with NCS experience and knowledge of the operations perform the reviews?
- Do the reviews examine CSEs do verify that changes to the process have not compromised criticality safety?
- Are the results of the review reported to senior management as well as Facility and Program Management?
- Are deficiencies and proposed corrective actions documented and tracked to closure?
- Are procedures in place that verify that changes to process equipment over time have not degraded compliance with criticality safety controls?
- Does the annual review of operations verify the vertical traceability of controls from floor level documents back to the parent CSE including verification that these chains are current and maintained properly?
- Do annual reviews of operations look at all the elements of the criticality safety program affecting operations?

5.0 PROCESS EVALUATION FOR NUCLEAR CRITICALITY SAFETY

Criteria: Section 8.1, Analysis of New and Modified Operations

Criticality safety evaluations shall conform to the requirements of ANSI/ANS-8.1, “Nuclear Criticality Safety in Operation with Fissionable Material Outside Reactors.”

- Are natural phenomena hazards, especially seismic, considered in developing accident scenarios?
- Are firefighting scenarios considered (i.e. addition of moderator, displacement of fissile material in water streams, etc.)?
- Do the contingencies credited represent events that are at least unlikely and incorporate lessons learned from previous process upsets and infraction of NCS limits?
- Are the contingencies to be evaluated jointly developed by the NCS staff, responsible operations personnel, and responsible support engineering organization?
- Is there a systematic approach that provides reasonable assurance that all credible criticality accident scenarios/initiators have been identified and understood?
- Are all credible process upsets considered and either controlled or dispositioned appropriately?
- Are the criticality safety evaluations performed in a timely fashion?
- Do formalized procedures exist for generating criticality safety evaluations?
- Does staff familiar with the facility and operations under consideration perform the criticality safety evaluations?
- Does the NCS Staff take full advantage of simplifying methods, bounding calculations, critical experiment data, handbook data, etc. where appropriate to minimize dependence upon monte carlo techniques?
- Are calculations validated by comparison to applicable experiment benchmark data?
- Is the Applicable Ranges of Bounding Curves and Data (AROBCAD) technique used to select and verify applicability of the selected benchmarks?
- Does the NCS Staff have access to archived criticality safety evaluations as reference?
- Do criteria and procedures exist to determine the magnitude of process change, which can be implemented without revising the criticality safety evaluation?
- Does the NCS Staff work as a team with operations to develop credible accident scenarios and controls?

Criteria: Section 8.2, Evaluation of Controlled Parameters

- Are controls developed in the criticality safety evaluation for each contingency?
- Do criticality safety evaluations and procedures for evaluations emphasize the preference for engineered controls over administrative controls?

- Are evaluation procedures in place to identify potential engineered controls and propose them to operations supervision for formal disposition? Do evaluations justify selection of administrative controls instead of engineered controls where the latter are practicable?
- Have computer-assisted techniques been utilized to enhance administrative controls and reduce failure rates?
- Are controlled parameters, contingencies, and credited barriers explicitly documented?
- Does the criticality safety evaluation identify those controls that are to be included in procedures and those that should be included in postings?

Criteria: Section 8.3, Documentation Requirements

- Do the criticality safety evaluations conform to DOE-STD-3007-93, *Guidelines for Preparing Criticality Safety Evaluations at Department of Energy Non-Reactor Nuclear Facilities*?
- Do the CSEs contain a system/process description with enough detail for an independent reviewer to understand the system/process sufficiently to judge the results of the criticality safety analysis?
- Is there a change control and document control system in place for criticality safety evaluations?
- Are internal memoranda used to communicate limits and controls in place of formal evaluations?
- Are temporary limits and evaluations (i.e. those that expire after a specified period) used?
- Are all assumptions fully documented in the criticality safety evaluation?
- Can appropriate sections of the criticality safety evaluation (e.g. the process description, discussion of contingencies and credible abnormal events, criticality safety controls) be read and understood by the line supervision?

Criteria: Section 8.4, Independent Review

- Do all criticality safety evaluations receive and independent technical peer review before approval for use?
- Does the independent review process provide assurance that engineered controls are given preference over administrative controls where practical?
- Is there a process for confirming that all credited engineered features of a system or process are in place and meet the specifications anticipated by the evaluation prior to starting operations?

6.0 MATERIALS CONTROL

Criteria: Section 9.1, Fissile Material Movement

- Are procedures in place to control the movement of fissile material between material balance areas?
- Are procedures in place to control movement of fissile material within a single material balance area?
- Are procedures in place to control transfers of fissile material out of the facility?
- Do the procedures have requirements to verify compliance with criticality safety limits at the shipping and receiving points of the transfer prior to performing the movement?
- Is there a formal process to maintain a running log of fissile mass contained in gloveboxes, storage arrays, etc.?

Criteria: Section 9.2, Labeling and Posting Requirements

- Do fissile material labels contain all the information necessary to determine compliance to applicable NCS controls such as fissile mass, cladding, moderators, chemical form, shape, isotopic composition, etc.?
- Are all fissile material storage areas posted as such with criticality controls clearly identified?
- Can the mass and location of all fissile materials in a glovebox be determined by inspection of logs posted on the glovebox?

- Can the operator readily determine compliance with applicable limits from the information available at the workstation?

Criteria: Section 9.3, Use of Neutron Absorbers

Any use of borosilicate raschig rings shall conform to the requirements of ANSI/ANS-8.5, "Use of Borosilcate-Glass Raschig Rings as a Neutron Absorber in Solutions of Fissile Material."

- Are any processes dependent upon the presence of fixed neutron absorbers?
- Are controls in place to monitor the continued effectiveness of credited neutron absorbers?
- Are any soluble neutron absorbers credited?
- If soluble neutron absorbers are credited, are procedures in place to ensure they remain in their intended distribution and concentration?
- Are practices dealing with fixed neutron absorbers generally consistent with ANSI/ANS-8.21, *Use of Fixed Neutron Absorbers in Nuclear Facilities Outside Reactors?"*

Criteria: Section 9.4, Control of Fissile Material Areas

- Is access to fissile material handling areas controlled such that only trained, qualified, and authorized personnel can handle fissile material?
- Does facility management verify the qualification of fissile material handlers prior to authorizing work?

Criteria: Section 9.5, Control of Physical Parameters

Are fissile material storage areas in conformance with the requirements of ANSI/ANS-8.7, "Guide for Nuclear Criticality Safety in the Storage of Fissile Materials" where applicable?

- Are containers of residue and product fissile material stored in fixed arrays or have engineered spacers attached?
- When administrative spacing controls are used, has the criticality safety evaluation demonstrated that the system will remain subcritical in a seismic event?
- Are administrative spacing controls credited as unlikely events in criticality safety evaluations?
- Where engineered features are credited for criticality control, are inspections conducted to verify they are capable of performing the intended function?
- For solution storage areas are procedures in place to detect concentration and stratification changes in the solution?
- Are unsafe liquid levels or unsafe solution concentrations prevented by engineered controls where practical?
- Are fissile solutions periodically monitored for changes in pH?
- Do double-block-and-bleed valve arrangements, or equivalent, where the addition of fissile material is prohibited, protect isolated, inactive fissile solution storage tanks?
- Has the criticality safety evaluation determined that all storage vaults, gloveboxes, and solution storage arrays will remain subcritical under the same design conditions the building /structure is designed to withstand (seismic events, flooding, high winds, etc.)?
- Does the CSE evaluate the effects of credible, within design basis, natural phenomena events and show that no single credible abnormal event can cause a criticality accident?
- Does fissile material holdup in process vessels, gloveboxes, the HVAC, and other accumulation points present a credible criticality accident scenario?
- Is holdup of fissile material monitored and controlled?
- Will fissile material remain subcritical under credible firefighting scenarios?

7.0 PLANNED RESPONSE TO NUCLEAR CRITICALITY ACCIDENTS

Criteria: Section 10.1, Criticality Accident Alarm Systems

- Is there a policy for how criticality accident alarm systems are evaluated and approved?
- Does documentation exist to demonstrate that the installed criticality detectors can detect the minimum accident of concern?
- Does documentation exist to show that existing criticality detector coverage provides the necessary redundancy and detection thresholds?
- Is there one group responsible for analyzing criticality detector locations?
- Is there a procedure that governs the evaluation of criticality detector locations?
- Is there a documented analysis showing that the criticality alarm is audible at all occupied locations subject to an expected dose of 12 read in free air?
- Is there documentation that the audible alarm signal requirements of ANSI/ANS-8.3 are satisfied?
- Where audible alarms do not satisfy ANSI/ANS-8.3 signal requirements, are beacons present and visible?
- Is the criticality accident alarm system designed to minimize false alarms?
- Is there an organization responsible for the design, maintenance and testing of criticality accident alarm system hardware?
- Is testing and maintenance of criticality accident alarm systems performed to approved procedures?
- When portable, temporary alarms are used do they meet the requirements of ANSI/ANS-8.3?
- Before portable, temporary alarms are used is there an analysis to demonstrate that the detectors will alarm if the minimum accident of concern occurs?

Criteria: Section 10.2, Emergency Procedures

- Are emergency procedures available and approved?
- Do offsite organizations participate in emergency exercises for criticality scenarios?
- Do offsite organizations required to respond in the event of a criticality accident have emergency response procedures?
- Does the NCS Staff have a role in responding to criticality accidents?
- Are procedures in place to provide estimates of source terms and fission estimates in the event of a criticality accident?
- Are offsite responders aware of the plant conditions that might be encountered in the event of a criticality accident?

Criteria: Section 10.3, Evacuation Practices

- Do emergency procedures designate evacuation routes?
- Are evacuation routes identified and avoid areas of higher risk?

Criteria: Section 10.4, Personnel Accounting

- Are personnel assembly stations clearly identified?
- Have the designated assembly areas been analyzed in advance to minimize radiation exposures from a criticality accident?
- Do procedures exist to account for all facility personnel, including visitors, in the event of an evacuation?

Criteria: Section 10.5, Training and Drills

- Are personnel trained to evacuate by the quickest and most direct route?
- Do personnel know where they are to assemble?
- Are criticality drills performed at least annually?
- Are annual criticality drills an OSR requirement?
- Does the alarm tone for a drill mimic the alarm that will be heard in a real accident?
- Are personnel pre-staged for criticality alarm drills or are they at their normal work locations?
- Do multiple buildings participate in criticality alarm drills?
- Will more than one facility go into alarm if a criticality accident occurs?
- Are facility visitors indoctrinated in proper evacuation procedures?
- Is an emergency command center established for criticality accident drills?

Criteria: Section 10.6, Care for Injured and/or Contaminated Personnel

- Are procedures in place to care for injured and exposed personnel?
- Are area hospitals equipped and trained to handle personnel with extreme radiation exposures?
- Are procedures in place to deal with contaminated personnel?

Criteria: Section 10.7, Personnel Dosimetry

- Do radiation monitoring personnel participate in criticality drills?
- Do radiation monitoring personnel respond to the assembly areas to monitor for radioactive contamination?

Criteria: Section 10.8, Radiation Detection Instrumentation

- Are procedures in place to monitor radiation levels at the assembly areas?
- Are appropriate radiation detectors available to ascertain the state of a criticality accident that has occurred?
- Are radiation monitoring personnel trained in the interpretation of radiation data as it pertains to an ongoing criticality accident?
- Are procedures in place to move personnel from designated assembly areas in the event an unacceptably high radiation field is encountered?
- Are radiation readings reported to the emergency command center?

Criteria: Section 10.9, Re-Entry Procedures

- Do emergency response procedures address re-entry and clearly identify the incident commander responsible for approving re-entry?
- Can the criticality alarm system be reset remotely prior to re-entry?
- What is the membership of re-entry teams?
- Are members trained in the use of proper equipment such as portable radiation monitoring equipment, portable communications equipment and supplied breathing air?
- Are members trained in the types of assignments they will likely be asked to perform and trained in the types of actions they should avoid (i.e., increasing the risk of high exposure of inadvertent actions that could result in re-criticality)?
- Does the incident commander have pre-determined criteria for authorizing re-entry?

DOE-STD-1158-2002

CONCLUDING MATERIAL

Review Activity:

DOE

DP-NNSA
EH
EM
NE
SC
RW
NN-NNSA

Area/Site Offices:

Amarillo Site Office
Argonne Area Office
Brookhaven Area Office
Fermi Area Office
Kirtland Site Office
Los Alamos Site Office
Princeton Area Office
Y-12 Site Office

Field and Operations Offices

AL
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ID
NV
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OAK
ORP
RF
RL
SR

Preparing Activity:

DOE EH-21

Project Number:

SAFT-0086