SRR-RP-2009-00558-018

STANDARDS/REQUIREMENTS IDENTIFICATION DOCUMENT

FUNCTIONAL AREA 18.0

NUCLEAR AND PROCESS SAFETY (U)

October 31, 2019
REVISION 19-07

Savannah River Remediation LLC
Savannah River Site
Aiken, SC 29808

PREPARED FOR THE U.S. DEPARTMENT OF ENERGY UNDER CONTRACT NO. DE-AC09-09SR22505

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18.00 NUCLEAR AND PROCESS SAFETY

Standards/Requirements Identification Document (S/RID) Functional Area 00, S/RID Purpose and Development, contains general information on the development (including the type of source documents considered), assessment, approval, and maintenance of the Savannah River Remediation LLC (SRR) S/RID which is pertinent to the understanding of this S/RID functional area. The reader should refer to S/RID Functional Area 00 for a complete understanding of this S/RID functional area.

This document addresses the Environmental, Safety and Health (ES&H) requirements related to Nuclear and Process Safety activities at the Savannah River Site (SRS). The Nuclear and Process Safety S/RID Functional Area encompasses all aspect of nuclear criticality and process safety, which ensure that nuclear facilities are sited, designed, constructed, modified, operated, maintained, and decommissioned in accordance with established safety requirements. Requirements are specified that ensure radioactive, fissionable materials and other hazardous materials are produced, processed, stored, transferred, and handled, in such a manner that the probability and consequences of an accident are acceptably low. Nuclear and Process Safety Programs ensure that: identifiable risks (nuclear and non-nuclear) to nuclear facilities are reduced to acceptable low levels; the safety bases for operation are adequately documented; and operations personnel, public and property are protected from the effects of potential accidents. The sources for the requirements which govern Nuclear and Process Safety activities are primarily contained in the DOE Regulations, Orders and Standards that relate to Nuclear and Process Safety and section eight of the American Nuclear Society (ANS) Standard. This functional area also includes the requirements for Authorization Agreements between SRR and Department of Energy (DOE)-Savannah River (SR) for Hazard Category 1 and 2 nuclear facilities or other high hazard facilities as determined by DOE-SR.

The functional area is being revised to incorporate the changes to requirements per DOE O 420.1C, Change **2**.

The functional area has been revised to incorporate the requirements of DOE O 420.1C, **Change 2**, Facility Safety. SRNS request for concurrence of interpretations or additional guidance was provided to DOE-SR via SRNS-U1000-2013-00102. DOE-SR concurrence in part with the SRNS positions were provided with exceptions, comments, and clarifications in OSQA-14-0044.

DOE O 420.1C, **Change 2,** Nuclear Criticality Safety (Attachment 2, Chapter III), is applicable to DOE elements and DOE contractors with responsibility for nuclear facilities and activities that involve or will potentially involve radionuclides in such quantities that are equal to or greater than the single parameter limits for fissionable materials listed in ANS-8.1 2014, Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors, and ANS-8.15-1981, Nuclear Criticality Control of Special Actinide Elements. These limits must be adjusted where process conditions could credibly involve moderators or reflectors that are more effective than light water.

Clarifications are annotated in the requirements text in Table 1 using “Modified for SRR use.” The letters noted above are referenced in the remarks section in Table 2 for the affected requirements.

18.01 MANAGEMENT

There are no requirements included in this section. However, on-site Management is governed by SRR procedures.

18.02 SAFETY REVIEWS

The requirements for performing safety reviews are contained in the Management Systems S/RID Functional Area. There are no additional requirements included in this section.

18.02.01 Independent Peer Review

The requirements for performing safety reviews are contained in the Management Systems S/RID Functional Area. There are no additional requirements included in this section.

18.02.02 Operations Review

The requirements for performing safety reviews are contained in the Management Systems S/RID Functional Area. There are no additional requirements included in this section.

18.02.03 Safety Oversight Review

The requirements for performing safety reviews are contained in the Management Systems S/RID Functional Area. There are no additional requirements included in this section.

18.03 SAFETY BASIS

This section contains requirements that ensure a defined and agreed upon Safety Basis and Authorization Agreement for conducting and assessing operations are established and used.

18.03.01 Documented Safety Analysis

The requirements contained in this section relate to the development, update, review, and approval process of the Safety Basis and Documented Safety Analysis. Specifically, a documented safety analysis provides a formal system to give reasonable assurance that facilities can be operated in a manner that limits risks to the facility personnel and general public and adequately protects property and the environment.

This section also contains requirements that apply to Hazard Classification of facilities.

18.03.02 Hazard Classification

The requirements for performing Hazard Classification are contained in section 18.03.01. There are no additional requirements included in this section.

18.03.03 Authorization Agreement

The requirements contained in this section relate to the development and approval process for Authorization Agreements. The Authorization Agreements between DOE-SR and SRR set forth the basis on which DOE-SR authorizes SRR to operate selected facilities. The Authorization Agreements provide terms and conditions that both parties rely on to demonstrate that a facility can be operated safely and in compliance with all applicable laws and regulations relating to worker and public safety and protection of the environment.

18.04 TECHNICAL SAFETY REQUIREMENTS

Technical Safety Requirements (TSRs) are documents that define the conditions, safe boundaries, and the requirements necessary to ensure the safe operation of a nuclear facility and to reduce the potential risk to the public and facility workers from uncontrolled releases of hazardous materials or from radiation exposures. This section contains requirements for development, documentation, review, approval, and implementation of the TSRs.

18.05 UNREVIEWED SAFETY QUESTIONS

This section includes requirements for the development of a process for review of Unreviewed Safety Questions (USQs). Requirements are included for evaluation of proposed changes in design or operations that may challenge the limits set forth in the safety basis documents.

18.06 NUCLEAR CRITICALITY SAFETY

This section contains requirements which ensure that fissionable materials are produced, stored, processed, transferred, disposed, or handled in such a manner that the probability of a criticality incident is acceptably low.

The sources for the requirements included in this functional area are the DOE Orders and standards listed in the reference section.

18.07 STABILIZATION, PACKAGING, AND STORAGE OF PLUTONIUM-BEARING MATERIALS

This section contains requirements pertaining to the stabilization, packaging, and storage of plutonium-bearing materials.

The sources for the requirements included in this section are from DOE-STD-3013-2012. This Standard does not apply to SRR.

18.08 KEY INTERFACES

The key interfaces between the Nuclear and Process Safety S/RID Functional Area and other S/RID functional areas are identified and described in the following sections.

18.08.01 Management Systems

An interface to Management Systems ensures that a commitment to Nuclear and Process Safety is incorporated into every aspect of operations at the highest management level. Refer to the Management Systems S/RID Functional Area 01 for requirements that relate to management oversight.

18.08.02 Quality Assurance

An interface with Quality Assurance (QA) ensures that QA programs and requirements applicable to Nuclear and Process Safety are incorporated into nuclear and process safety programs and activities. For example, ANS-8.14 and ANS-8.21 contain QA programmatic requirements that are duplicative of requirements addressed under the Quality Assurance S/RID Functional Area. For requirements related to QA refer to the Quality Assurance S/RID Functional Area 02.

18.08.03 Configuration Management

Activities in the Configuration Management functional area must interface to the Nuclear and Process Safety functional area to ensure that modifications will not compromise Nuclear and Process Safety, and that new activities receive the proper review in case additional safety requirements are needed. Refer to the Configuration Management S/RID functional area for such requirements.

18.08.04 Training and Qualifications

An interface with Training and Qualification ensures that Training and Qualification programs and requirements are incorporated into Nuclear and Process Safety programs and activities. For example, ANS 8.20 contains general criticality safety training requirements, and ANS 8.26 contains criticality safety engineer training and qualification requirements. The Criticality Safety Program interface with the Site Training Program ensures these requirements are addressed consistent with site training programs.

18.08.06 Safeguards and Security

Safeguards and Security requirements have a relationship to the protection of the environment, health and safety of the workers and the public as specified (through reference). Requirements related to safeguards and security are managed as non-S/RID requirements in accordance with Contract Clause I.38.

18.08.07 Engineering Program

Interface to the Engineering Program S/RID Functional Area ensures that a review of new construction and modifications is performed to identify additional engineered Nuclear and Process Safety features, and to ensure that the impact of modifications on current safety features is evaluated. Refer to the Engineering Program S/RID Functional Area 07 for the specification of such requirements.

18.08.08 Conduct of Operations

An interface to the Conduct of Operations S/RID Functional Area ensures that Nuclear and Process Safety principles are incorporated into daily operations. Refer to the Conduct of Operations S/RID Functional Area 09 for such requirements.

18.08.09 Maintenance

An interface with the Maintenance S/RID Functional Area ensures that maintenance personnel are familiar with areas containing material with the potential for accidental criticality events, and that engineered safety systems requiring maintenance are properly serviced. For maintenance activities that may have an effect on Nuclear and Process Safety requirements refer to the Maintenance S/RID Functional Area 10.

18.08.10 Radiation Protection

An interface with Radiation Protection ensures that radiation protection programs and requirements are incorporated into Nuclear and Process Safety programs and activities. For example, American Nuclear Society (ANS) criticality safety standard ANS 8.23 contains radiation protection requirements. The Criticality Safety program interface with the Radiation Protection Program ensures these requirements are addressed consistent with the site radiation protection program.

18.08.11 Packaging and Transportation

Physical management of nuclear materials requires an interface to the Packaging and Transportation S/RID Functional Area to ensure proper labeling, packaging, and transportation of such materials. The Safety Analysis Reports for Packaging (SARPs), for off-site nuclear packages, and the Onsite Safety Assessments (OSAs), for on-site nuclear packages, demonstrates the safety of such packages. Requirements for the SARPs and OSAs are contained in the Packaging and Transportation S/RID Functional Area 13.

18.08.12 Research and Development and Experimental Activities

The Research and Development/Experimental Activities S/RID Functional Area can involve the use of fissionable materials, other radioactive substances, and hazardous materials. The requirements identified in the Nuclear and Process Safety S/RID Functional Area are strictly applied to such research and experimental activities. Research, development, and experimental projects performed at Savannah River Site will be governed by the functional area requirements that apply to the activities being performed. Therefore, no requirements are specified in the Research and Development/Experimental Activities S/RID Functional Area 17.

18.08.13 Fire Protection

Requirements relating to Fire Protection that ensure protection of ES&H with respect to Nuclear and Process Safety are specified in the Fire Protection S/RID Functional Area 12.

18.09 DOCUMENTS

18.09.01 Reference Documents

10 CFR 830	NUCLEAR SAFETY MANAGEMENT
ANS 8.1	NUCLEAR CRITICALITY SAFETY IN OPERATIONS WITH FISSIONABLE MATERIALS OUTSIDE REACTORS, 2014, 4/15/2014
ANS 8.10	CRITERIA FOR NUCLEAR CRITICALITY SAFETY CONTROLS IN OPERATIONS WITH SHIELDING AND CONFINEMENT, 2015, 2/12/2015
ANS 8.12	NUCLEAR CRITICALITY CONTROL AND SAFETY OF PLUTONIUM-URANIUM FUEL MIXTURES OUTSIDE REACTORS, 1987, 2/11/2011
ANS 8.14	USE OF SOLUBLE NEUTRON ABSORBERS IN NUCLEAR FACILITIES OUTSIDE REACTORS, 2004, 11/16/2011
ANS 8.15	NUCLEAR CRITICALITY CONTROL OF SELECTED ACTINIDE ELEMENTS, 2014, 10/10/2014
ANS 8.17	CRITICALITY SAFETY CRITERIA FOR THE HANDLING, STORAGE, AND TRANSPORTATION OF LWR FUEL OUTSIDE REACTORS, 2004, 7/28/2014

ANS 8.19	ADMINISTRATIVE PRACTICES FOR NUCLEAR CRITICALITY SAFETY, 2014, 7/28/2014
ANS 8.20	NUCLEAR CRITICALITY SAFETY TRAINING, 1991, 9/16/2005
ANS 8.21	USE OF FIXED NEUTRON ABSORBERS IN NUCLEAR FACILITIES OUTSIDE REACTORS, 1995, 5/19/2011
ANS 8.22	NUCLEAR CRITICALITY SAFETY BASED ON LIMITING AND CONTROLLING MODERATORS, 1997, 11/11/2011
ANS 8.23	NUCLEAR CRITICALITY ACCIDENT EMERGENCY PLANNING AND RESPONSE, 2007, 5/31/2012
ANS 8.24	VALIDATION OF NEUTRON TRANSPORT METHODS FOR NUCLEAR CRITICALITY SAFETY CALCULATIONS, **2017**, **12/12/2017**
ANS 8.26	CRITICALITY SAFETY ENGINEER TRAINING AND QUALIFICATION PROGRAM, 2007, 5/31/2012
ANS 8.27	BURNUP CREDIT FOR LWR FUEL, **2015**, **11/10/2015**
ANS 8.3	CRITICALITY ACCIDENT ALARM SYSTEM, 1997, 7/26/2012
ANS 8.6	SAFETY IN CONDUCTING SUBCRITICAL NEUTRON-MULTIPLICATION MEASUREMENTS IN SITU, 1983, 11/16/2010
ANS 8.7	NUCLEAR CRITICALITY SAFETY IN THE STORAGE OF FISSILE MATERIALS, 1998, 2/23/2012
DOE LETTER OSQA-15-0081	SAVANNAH RIVER REMEDIATION LLC (SRR) CANCELLED DIRECTIVE IMPLEMENTATION INSTRUCTIONS (DII) GUIDANCE, 4/8/2015
DOEO420.1C	FACILITY SAFETY, CHANGE **2, 7/26/2018**

TABLE 1 FORMAT AND CONTENT

S/RID Requirement Number	Unique number for each requirement that links the statement to the ES&H Configuration Guide
Source Document	Number of the source document
Source Document Requirement Number	Unique reference from the source document.
Requirement Text	Requirement statement

Facility Categories *

Requirement applicability is shown in relation to the following facility categories:

Nuclear HC-1,2,3	Representing nuclear hazard category 1, 2 and 3 facilities (as defined by DOE Standard 1027-92) and includes any facility(s) required to support a nuclear facility(s).
Radiological	Representing facilities below Hazard Category 3 but still contain quantities of radioactive material at or above the Reportable Quantity value as specified in 40 CFR 302.4, Appendix B.
High Hazard Chemical	Representing facilities with radiological hazards below 40 CFR 302.4 thresholds for radiological materials, but with any chemical hazard at or above threshold quantities listed in 29 CFR 1910.119 or 40 CFR 68. These facilities may also contain nuclear materials exempt from the nuclear facility definition, e.g., check and calibration sources, radioactive sources in research and experimental and analytical laboratory activities, electron microscopes, and x-ray machines, as defined by 10 CFR 830.3.
Low Hazard Chemical	Representing facilities with radiological hazards below 40 CFR 302.4 thresholds, but with chemical hazards both below 29 CFR 1910.119 or 40 CFR 68 thresholds and at or above reportable quantities in 40 CFR 302.4. These facilities may also contain nuclear materials exempt from the nuclear facility definition, e.g., check and calibration sources, radioactive sources in research and experimental and analytical laboratory activities, electron microscopes, and x-ray machines, as defined by 10 CFR 830.3.
Other Industrial	Representing facilities with all radiological and chemical hazards below 40 CFR 302.4 thresholds. These facilities may also contain nuclear materials exempt from the nuclear facility definition, e.g., check and calibration sources, radioactive sources in research and experimental and analytical laboratory activities, electron microscopes, and x-ray machines, as defined by 10 CFR 830.3.
Facility Specific	These are requirements that are applicable to specific facilities. Facility identification is included in this column, when applicable.

Phase I Compliance Approach

Common	Implementation of these requirements is covered by common procedures and policies.
Facility Specific	Implementation of these requirements is covered by facility specific procedures.

* Refer to the "SRR Facilities List" contained in Functional Area 00 for the category for specific SRR facilities/bldgs.

FACILITY SPECIFIC LIST(S)

CRIT FACILITIES
See FA 00 for list of facilities

HC-1,2
Haz. Cat. 1, 2, and 3 See FA 00

TABLE 1 - S/RID FUNCTIONAL AREA 18 (NUCLEAR AND PROCESS SAFETY) REQUIREMENTS

S/RID Requirement Number	Source Document	Source Document Reqt Number	Requirement Text	SRR Applicability						Phase I Compliance	
				Nuclear HC-1,2,3	Radi-ological	High Hazard Chemical	Low Hazard Chemical	Other Industrial	Facility Specific	Common	Facility Specific
18.03.01.044	10 CFR 830	Sub.B.830.200	Scope. This Subpart establishes safety basis requirements for hazard category 1, 2, and 3 DOE nuclear facilities.	X						X	
18.03.01.045	10 CFR 830	Sub.B.830.201	Performance of work. A contractor must perform work in accordance with the safety basis for a hazard category 1, 2, or 3 DOE nuclear facility and, in particular, with the hazard controls that ensure adequate protection of workers, the public, and the environment.	X						X	
18.03.01.046	10 CFR 830	Sub.B.830.202(a)	Safety basis. The contractor responsible for a hazard category 1, 2, or 3 DOE nuclear facility must establish and maintain the safety basis for the facility.	X						X	
18.03.01.047	10 CFR 830	Sub.B.830.202(b)(1)	Safety basis. In establishing the safety basis for a hazard category 1, 2, or 3 DOE nuclear facility, the contractor responsible for the facility must: Define the scope of the work to be performed.	X						X	
18.03.01.048	10 CFR 830	Sub.B.830.202(b)(2)	Safety basis. In establishing the safety basis for a hazard category 1, 2, or 3 DOE nuclear facility, the contractor responsible for the facility must: Identify and analyze the hazards associated with the work.	X						X	
18.03.01.049	10 CFR 830	Sub.B.830.202(b)(3)	Safety basis. In establishing the safety basis for a hazard category 1, 2, or 3 DOE nuclear facility, the contractor responsible for the facility must: Categorize the facility consistent with DOE-STD-1027-92 (``Hazard Categorization and Accident Analysis Techniques for compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports," Change Notice 1, September 1997).	X						X	
18.03.01.050	10 CFR 830	Sub.B.830.202(b)(4)	Safety basis. In establishing the safety basis for a hazard category 1, 2, or 3 DOE nuclear facility, the contractor responsible for the facility must: Prepare a documented safety analysis for the facility.	X						X	
18.03.01.051	10 CFR 830	Sub.B.830.202(b)(5)	Safety basis. In establishing the safety basis for a hazard category 1, 2, or 3 DOE nuclear facility, the contractor responsible for the facility must: Establish the hazard controls upon which the contractor will rely to ensure adequate protection of workers, the public, and the environment.	X						X	
18.03.01.052	10 CFR 830	Sub.B.830.202(c)(1)	Safety basis. In maintaining the safety basis for a hazard category 1, 2, or 3 DOE nuclear facility, the contractor responsible for the facility must: Update the safety basis to keep it current and to reflect changes in the facility, the work and the hazards as they are analyzed in the documented safety analysis.	X						X	

TABLE 1 - S/RID FUNCTIONAL AREA 18 (NUCLEAR AND PROCESS SAFETY) REQUIREMENTS

S/RID Requirement Number	Source Document	Source Document Reqt Number	Requirement Text	SRR Applicability						Phase I Compliance	
				Nuclear HC-1,2,3	Radi-ological	High Hazard Chemical	Low Hazard Chemical	Other Industrial	Facility Specific	Common	Facility Specific
18.03.01.053	10 CFR 830	Sub.B.830.202(c)(2)	Safety basis. In maintaining the safety basis for a hazard category 1, 2, or 3 DOE nuclear facility, the contractor responsible for the facility must: Annually submit to DOE either the updated documented safety analysis for approval or a letter stating that there have been no changes in the documented safety analysis since the prior submission.	X						X	
18.03.01.054	10 CFR 830	Sub.B.830.202(c)(3)	Safety basis. In maintaining the safety basis for a hazard category 1, 2, or 3 DOE nuclear facility, the contractor responsible for the facility must: Incorporate in the safety basis any changes, conditions, or hazard controls directed by DOE.	X						X	
18.03.01.055	10 CFR 830	Sub.B.830.204(a)	Documented safety analysis. The contractor responsible for a hazard category 1, 2, or 3 DOE nuclear facility must obtain approval from DOE for the methodology used to prepare the documented safety analysis for the facility unless the contractor uses a methodology set forth in Table 2 of Appendix A to this Part. Note: For Table 2 of Appendix A, see S/RID FA 00	X						X	
18.03.01.056	10 CFR 830	Sub.B.830.204(b)(1)	Documented safety analysis. The documented safety analysis for a hazard category 1, 2, or 3 DOE nuclear facility must, as appropriate for the complexities and hazards associated with the facility: Describe the facility (including the design of safety structures, systems and components) and the work to be performed.	X						X	
18.03.01.057	10 CFR 830	Sub.B.830.204(b)(2)	Documented safety analysis. The documented safety analysis for a hazard category 1, 2, or 3 DOE nuclear facility must, as appropriate for the complexities and hazards associated with the facility: Provide a systematic identification of both natural and man-made hazards associated with the facility.	X						X	
18.03.01.058	10 CFR 830	Sub.B.830.204(b)(3)	Documented safety analysis. The documented safety analysis for a hazard category 1, 2, or 3 DOE nuclear facility must, as appropriate for the complexities and hazards associated with the facility: Evaluate normal, abnormal, and accident conditions, including consideration of natural and man-made external events, identification of energy sources or processes that might contribute to the generation or uncontrolled release of radioactive and other hazardous materials, and consideration of the need for analysis of accidents which may be beyond the design basis of the facility.	X						X	

TABLE 1 - S/RID FUNCTIONAL AREA 18 (NUCLEAR AND PROCESS SAFETY) REQUIREMENTS

S/RID Requirement Number	Source Document	Source Document Reqt Number	Requirement Text	SRR Applicability						Phase I Compliance	
				Nuclear HC-1,2,3	Radi-ological	High Hazard Chemical	Low Hazard Chemical	Other Industrial	Facility Specific	Common	Facility Specific
18.03.01.059	10 CFR 830	Sub.B.830.204(b)(4)	Documented safety analysis. The documented safety analysis for a hazard category 1, 2, or 3 DOE nuclear facility must, as appropriate for the complexities and hazards associated with the facility: Derive the hazard controls necessary to ensure adequate protection of workers, the public, and the environment, demonstrate the adequacy of these controls to eliminate, limit, or mitigate identified hazards, and define the process for maintaining the hazard controls current at all times and controlling their use. Note: For SRR operations, this requirement has been expanded per DOE-SR Letter OSQA-11-0029 (January 04, 2011) as follows: SRR shall designate Defense In Depth/Important to Safety (DID/ITS) features in their facilities' Documented Safety Analysis. These features will be selected based on guidance from OSQA-11-0029. This designation requires DOE concurrence prior to permanent removal or degradation of the DID/ITS safety function. These features do not require any Quality Assurance, Occurrence Reportability, Design, Maintenance or Operations requirements beyond that of General Services (GS) systems.	X						X	
18.03.01.060	10 CFR 830	Sub.B.830.204(b)(5)	Documented safety analysis. The documented safety analysis for a hazard category 1, 2, or 3 DOE nuclear facility must, as appropriate for the complexities and hazards associated with the facility: Define the characteristics of the safety management programs necessary to ensure the safe operation of the facility, including (where applicable) quality assurance, procedures, maintenance, personnel training, conduct of operations, emergency preparedness, fire protection, waste management, and radiation protection.	X						X	
18.03.01.061	10 CFR 830	Sub.B.830.204(b)(6)(i)	Documented safety analysis. The documented safety analysis for a hazard category 1, 2, or 3 DOE nuclear facility must, as appropriate for the complexities and hazards associated with the facility: With respect to a nonreactor nuclear facility with fissionable material in a form and amount sufficient to pose a potential for criticality, define a criticality safety program that: Ensures that operations with fissionable material remain subcritical under all normal and credible abnormal conditions.	X						X	

TABLE 1 - S/RID FUNCTIONAL AREA 18 (NUCLEAR AND PROCESS SAFETY) REQUIREMENTS

S/RID Requirement Number	Source Document	Source Document Reqt Number	Requirement Text	SRR Applicability						Phase I Compliance	
				Nuclear HC-1,2,3	Radi-ological	High Hazard Chemical	Low Hazard Chemical	Other Industrial	Facility Specific	Common	Facility Specific
18.03.01.062	10 CFR 830	Sub.B.830.204(b)(6)(ii)	Documented safety analysis. The documented safety analysis for a hazard category 1, 2, or 3 DOE nuclear facility must, as appropriate for the complexities and hazards associated with the facility: With respect to a nonreactor nuclear facility with fissionable material in a form and amount sufficient to pose a potential for criticality, define a criticality safety program that: Identifies applicable nuclear criticality safety standards.	X						X	
18.03.01.063	10 CFR 830	Sub.B.830.204(b)(6)(iii)	Documented safety analysis. The documented safety analysis for a hazard category 1, 2, or 3 DOE nuclear facility must, as appropriate for the complexities and hazards associated with the facility: With respect to a nonreactor nuclear facility with fissionable material in a form and amount sufficient to pose a potential for criticality, define a criticality safety program that: Describes how the program meets applicable nuclear criticality safety standards.	X						X	
18.03.01.064	10 CFR 830	Sub.B.830.206(a)	Preliminary documented safety analysis. If construction begins after December 11, 2000, the contractor responsible for a hazard category 1, 2, or 3 new DOE nuclear facility or a major modification to a hazard category 1, 2, or 3 DOE nuclear facility must: Prepare a preliminary documented safety analysis for the facility.	X						X	
18.03.01.065	10 CFR 830	Sub.B.830.206(b)(1)	Preliminary documented safety analysis. If construction begins after December 11, 2000, the contractor responsible for a hazard category 1, 2, or 3 new DOE nuclear facility or a major modification to a hazard category 1, 2, or 3 DOE nuclear facility must: Obtain DOE approval of: The nuclear safety design criteria to be used in preparing the preliminary documented safety analysis unless the contractor uses the design criteria in DOE Order 420.1, Facility Safety. **Note: DOE Order 420.1 is now DOE O 420.1C Change 2.**	X						X	

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				Nuclear HC-1,2,3	Radi-ological	High Hazard Chemical	Low Hazard Chemical	Other Industrial	Facility Specific	Common	Facility Specific
18.03.01.066	10 CFR 830	Sub.B.830.206(b)(2)	Preliminary documented safety analysis. If construction begins after December 11, 2000, the contractor responsible for a hazard category 1, 2, or 3 new DOE nuclear facility or a major modification to a hazard category 1, 2, or 3 DOE nuclear facility must: Obtain DOE approval of: The preliminary documented safety analysis before the contractor can procure materials or components or begin construction; provided that DOE may authorize the contractor to perform limited procurement and construction activities without approval of a preliminary documented safety analysis if DOE determines that the activities are not detrimental to public health and safety and are in the best interests of DOE.	X						X	
18.03.01.067	10 CFR 830	Sub.B.830.207(a)	DOE approval of safety basis. By April 10, 2003, a contractor responsible for a hazard category 1, 2, or 3 existing DOE nuclear facility must submit for DOE approval a safety basis that meets the requirements of this Subpart.	X						X	
18.03.01.068	10 CFR 830	Sub.B.830.207(b)	DOE approval of safety basis. Pending issuance of a safety evaluation report in which DOE approves a safety basis for a hazard category 1, 2, or 3 existing DOE nuclear facility, the contractor responsible for the facility must continue to perform work in accordance with the safety basis for the facility in effect on October 10, 2000, or as approved by DOE at a later date, and maintain the existing safety basis consistent with the requirements of this Subpart.	X						X	
18.03.01.069	10 CFR 830	Sub.B.830.207(c)	DOE approval of safety basis. If the safety basis for a hazard category 1, 2, or 3 existing DOE nuclear facility already meets the requirements of this Subpart and reflects the current work and hazards associated with the facility, the contractor responsible for the facility must, by April 9, 2001, notify DOE, document the adequacy of the existing safety basis and request DOE to issue a safety evaluation report that approves the existing safety basis. If DOE does not issue a safety evaluation report by October 10, 2001, the contractor must submit a safety basis pursuant to paragraph (a) of this section.	X						X	
18.03.01.070	10 CFR 830	Sub.B.830.207(d)	DOE approval of safety basis. With respect to a hazard category 1, 2, or 3 new DOE nuclear facility or a major modification to a hazard category 1, 2, or 3 DOE nuclear facility, a contractor may not begin operation of the facility or modification prior to the issuance of a safety evaluation report in which DOE approves the safety basis for the facility or modification.	X						X	

TABLE 1 - S/RID FUNCTIONAL AREA 18 (NUCLEAR AND PROCESS SAFETY) REQUIREMENTS

S/RID Requirement Number	Source Document	Source Document Reqt Number	Requirement Text	SRR Applicability						Phase I Compliance	
				Nuclear HC-1,2,3	Radi-ological	High Hazard Chemical	Low Hazard Chemical	Other Industrial	Facility Specific	Common	Facility Specific
18.03.01.073	10 CFR 830	Sub.B.830.App A(C)	Scope 1. A contractor must establish and maintain a safety basis for a hazard category 1, 2, or 3 DOE nuclear facility because these facilities have the potential for significant radiological consequences. DOE-STD-1027-92 (``Hazard Categorization and Accident Analysis Techniques for compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports," Change Notice 1, September 1997) sets forth the methodology for categorizing a DOE nuclear facility (see Table 1). The hazard categorization must be based on an inventory of all radioactive materials within a nuclear facility. 2. Unlike the quality assurance requirements of Part 830 that apply to all DOE nuclear facilities (including radiological facilities), the safety basis requirements only apply to hazard category 1, 2, and 3 nuclear facilities and do not apply to nuclear facilities below hazard category 3. Note: For Table 1 of Appendix A, see S/RID FA00.	X						X	

TABLE 1 - S/RID FUNCTIONAL AREA 18 (NUCLEAR AND PROCESS SAFETY) REQUIREMENTS

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18.03.01.076	10 CFR 830	Sub.B.830.App A(F)	Documented Safety Analysis 1. A documented safety analysis must demonstrate the extent to which a nuclear facility can be operated safely with respect to workers, the public, and the environment. 2. DOE expects a contractor to use a graded approach to develop a documented safety analysis and describe how the graded approach was applied. The level of detail, analysis, and documentation will reflect the complexity and hazard associated with a particular facility. Thus, the documented safety analysis for a simple, low hazard facility may be relatively short and qualitative in nature, while the documented safety analysis for a complex, high hazard facility may be quite elaborate and more quantitative. DOE will work with its contractors to ensure a documented safety analysis is appropriate for the facility for which it is being developed. 3. Because DOE has ultimate responsibility for the safety of its facilities, DOE will review each documented safety analysis to determine whether the rigor and detail of the documented safety analysis are appropriate for the complexity and hazards expected at the nuclear facility. In particular, DOE will evaluate the documented safety analysis by considering the extent to which the documented safety analysis (1) satisfies the provisions of the methodology used to prepare the documented safety analysis and (2) adequately addresses the criteria set forth in 10 CFR 830.204(b). DOE will prepare a Safety Evaluation Report to document the results of its review of the documented safety analysis. A documented safety analysis must contain any conditions or changes required by DOE. 4. In most cases, the contract will provide the framework for specifying the methodology and schedule for developing a documented safety analysis. Table 2 sets forth acceptable methodologies for preparing a documented safety analysis. 5. Table 2 refers to specific types of nuclear facilities. These references are not intended to constitute an exhaustive list of the specific types of nuclear facilities. Part 830 defines nuclear facility broadly to include all those facilities, activities, or operations that involve, or will involve, radioactive and/or fissionable materials in such form and quantity that a nuclear or a nuclear explosive hazard potentially exists to the employees or the general public, and to include any related area, structure, facility, or activity to the extent necessary to ensure proper implementation of the requirements established by Part 830. The only exceptions are those facilities specifically excluded such as accelerators. Table 3 defines the specific nuclear facilities referenced in Table 2 that are not defined in 10 CFR 830.3.	X						X	

TABLE 1 - S/RID FUNCTIONAL AREA 18 (NUCLEAR AND PROCESS SAFETY) REQUIREMENTS

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18.03.01.076	10 CFR 830	Sub.B.830.App A(F) (cont'd)	Documented Safety Analysis 6. If construction begins after December 11, 2000, the contractor responsible for the design and construction of a new DOE nuclear facility or of a major modification to an existing DOE nuclear facility must prepare a preliminary documented safety analysis. A preliminary documented safety analysis can ensure that substantial costs and time are not wasted in constructing a nuclear facility that will not be acceptable to DOE. If a contractor is required to prepare a preliminary documented safety analysis, the contractor must obtain DOE approval of the preliminary documented safety analysis prior to procuring materials or components or beginning construction. DOE, however, may authorize the contractor to perform limited procurement and construction activities without approval of a preliminary documented safety analysis if DOE determines that the activities are not detrimental to public health and safety and are in the best interests of DOE. DOE Order 420.1, Facility Safety, sets forth acceptable nuclear safety design criteria for use in preparing a preliminary documented safety analysis. As a general matter, DOE does not expect preliminary documented safety analyses to be needed for activities that do not involve significant construction such as environmental restoration activities, decontamination and decommissioning activities, specific nuclear explosive operations, or transition surveillance and maintenance activities. Notes: 1. For Table 2 and Table 3 of Appendix A, see S/RID FA 00. 2. **DOE Order 420.1 is now DOE O 420.1C Change 2.**	X						X	

TABLE 1 - S/RID FUNCTIONAL AREA 18 (NUCLEAR AND PROCESS SAFETY) REQUIREMENTS

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				Nuclear HC-1,2,3	Radi-ological	High Hazard Chemical	Low Hazard Chemical	Other Industrial	Facility Specific	Common	Facility Specific
18.03.01.077	10 CFR 830	Sub.B.830.App A(G)	Hazard Controls 1. Hazard controls are measures to eliminate, limit, or mitigate hazards to workers, the public, or the environment. They include (1) physical, design, structural, and engineering features; (2) safety structures, systems, and components; (3) safety management programs; (4) technical safety requirements; and (5) other controls necessary to provide adequate protection from hazards. 2. The types and specific characteristics of the safety management programs necessary for a DOE nuclear facility will be dependent on the complexity and hazards associated with the nuclear facility and the work being performed. In most cases, however, a contractor should consider safety management programs covering topics such as quality assurance, procedures, maintenance, personnel training, conduct of operations, criticality safety, emergency preparedness, fire protection, waste management, and radiation protection. In general, DOE Orders set forth DOE's expectations concerning specific topics. For example, DOE Order 420.1 provides DOE's expectations with respect to fire protection and criticality safety. 3. Safety structures, systems, and components require formal definition of minimum acceptable performance in the documented safety analysis. This is accomplished by first defining a safety function, then describing the structure, systems, and components, placing functional requirements on those portions of the structures, systems, and components required for the safety function, and identifying performance criteria that will ensure functional requirements are met. Technical safety requirements are developed to ensure the operability of the safety structures, systems, and components and define actions to be taken if a safety structure, system, or component is not operable. 4. Technical safety requirements establish limits, controls, and related requirements necessary for the safe operation of a nuclear facility. The exact form and contents of technical safety requirements will depend on the circumstances of a particular nuclear facility as defined in the documented safety analysis for the nuclear facility. As appropriate, technical safety requirements may have sections on (1) safety limits, (2) operating limits, (3) surveillance requirements, (4) administrative controls, (5) use and application, and (6) design features. It may also have an appendix on the bases for the limits and requirements. DOE Guide 423.X, Implementation Guide for Use in Developing Technical Safety Requirements (TSRs) provides a complete description of what technical safety requirements should contain and how they should be developed and maintained.	X						X	

TABLE 1 - S/RID FUNCTIONAL AREA 18 (NUCLEAR AND PROCESS SAFETY) REQUIREMENTS

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18.03.01.077	10 CFR 830	Sub.B.830.App A(G) (cont'd)	Hazard Controls 5. DOE will examine and approve the technical safety requirements as part of preparing the safety evaluation report and reviewing updates to the safety basis. As with all hazard controls, technical safety requirements must be kept current and reflect changes in the facility, the work and the hazards as they are analyzed in the documented safety analysis. In addition, DOE expects a contractor to maintain technical safety requirements, and other hazard controls as appropriate, as controlled documents with an authorized users list. 6. Table 4 sets forth DOE's expectations concerning acceptable technical safety requirements. Notes: 1. For Table 4 of Appendix A, see S/RID FA 00. 2. The Implementation Guide for developing TSRs is DOE Guide 423.1-1. 3. **DOE Order 420.1 is now DOE O 420.1C Change 2.**	X						X	

TABLE 1 - S/RID FUNCTIONAL AREA 18 (NUCLEAR AND PROCESS SAFETY) REQUIREMENTS

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18.03.01.101	DOEO420.1C	Att. 1.1.e-f	1. GENERAL REQUIREMENTS e. When the DOE-STD-3009 methodology is used to satisfy 10 Code of Federal Regulations (C.F.R.) Part 830, Nuclear Safety Management, contractors must prepare Documented Safety Analyses (DSAs) in accordance with DOE-STD-3009-2014, Preparation of Nonreactor Nuclear Facility Documented Safety Analysis, for new DOE non-reactor nuclear facilities and major modifications to existing DOE non-reactor nuclear facilities. Note: for such major modifications to existing non-reactor nuclear facilities, the appropriate Head of Departmental Element, with concurrence by the applicable Central Technical Authority, may approve use of DOE-STD-3009-94, Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses, Chg. Notice 3. f. Contractors must carry out the analysis prescribed in Section 3.3.1 of DOE-STD-3009-2014 and include the results of this analysis in applicable DSAs for existing DOE nuclear facilities and activities whenever the safety analysis concludes that the mitigated off-site dose consequences for one or more accident scenarios exceed the Evaluation Guideline of 25 rem. Modified for SRR use by SRNS-U10000-2013-00102 and OSQA-14-0044: During development of the implementation of this Order, the Department will work with the Contractors and carefully review the Order to identify those Standards or parts of Standards that are considered mandatory. Note: Att. 1.1.a-d is included in FA 07	X	X	X	X	X		X	
18.03.03.016	DOE LETTER OSQA-15-0081	Encl. 2.3.a.	RESPONSIBILITIES AND AUTHORITIES. a. The contractor shall submit to DOE an Authorization Agreement (AA) acknowledging the conditions and requirements binding on the contractor when DOE authorizes operations to be initiated and conducted at Hazard Category 1 and 2 Nuclear Facilities or other high hazard facility as determined by DOE.						(+) HC-1,2		X
18.03.03.017	DOE LETTER OSQA-15-0081	Encl. 2.3.b.	RESPONSIBILITIES AND AUTHORITIES. b. The S/RID shall reflect the requirements for AAs for Hazard Category 1 and 2 Nuclear Facilities and additional high hazard facilities requiring an AA.						(+) HC-1,2		X

TABLE 1 - S/RID FUNCTIONAL AREA 18 (NUCLEAR AND PROCESS SAFETY) REQUIREMENTS

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18.03.03.018	DOE LETTER OSQA-15-0081	Encl. 2.3.c.	RESPONSIBILITIES AND AUTHORITIES. c. The contractor shall develop its AA policies, guidance, and procedures consistent with this Enclosure.						(+) HC-1,2		X
18.03.03.019	DOE LETTER OSQA-15-0081	Encl. 2.3.d.	RESPONSIBILITIES AND AUTHORITIES. d. The contractor shall refer AA programmatic issues that require clarification or interpretation to the DOE Office of Safety and Quality Assurance.						(+) HC-1,2		X
18.03.03.020	DOE LETTER OSQA-15-0081	Encl. 2.3.e.	RESPONSIBILITIES AND AUTHORITIES. e. The contractor shall have provided, in advance of presenting the AA for DOE approval, documentation and other evidence of having satisfied DOE's bases for authorizing the commencement of an activity or operation of a facility. Those bases to be satisfied are, at a minimum: 1) Standards and Requirements Basis - Appropriate requirements for safe operation of the subject facility or activity have been included in the S/RID and approved by DOE. The facility is ready for implementation. 2) Safety Basis - Safety Basis (SB) documents have been developed for the subject facility or activity and have been submitted to and approved by DOE. The facility is ready for implementation. 3) Environmental Basis - All required NEPA documents and environmental permits for the subject facility or activity, such as air and water discharge permits, have been submitted to, and approved by, the appropriate authority. The facility is in compliance with the permits. 4) Competency Basis - The Contractor Company, by virtue of the selection process and having been awarded the contract to conduct the activity or facility operation, has been documented to be competent to conduct such operations. The contractor shall keep and, upon request, provide documentation that the company's personnel have and maintain the requisite qualifications for conducting the assigned work at the subject facility. 5) Operational Readiness Basis - The appropriate readiness confirmation process shall have been conducted and shall have found no impediments to startup/restart of the subject activity or facility operation. All of the required controls for safe operation shall be ready for implementation when the AA is presented to DOE for approval. 6) Other Basis - Any other consideration, i.e. Emergency Preparedness Basis, Radioactive Waste Management Basis, Safeguard and Security, that DOE relies on for deciding that operation can be authorized to commence, or continue, while protecting the workers, the public and the environment.						(+) HC-1,2		X

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18.03.03.021	DOE LETTER OSQA-15-0081	Encl. 2.3.f.	RESPONSIBILITIES AND AUTHORITIES. f. Any compensatory measures applied as a bridge to full compliance with the referenced "basis" documentation described in paragraph 3.e. above, shall be described in and made a condition of the AA.						(+) HC-1,2		X
18.03.03.022	DOE LETTER OSQA-15-0081	Encl. 2.3.g.	RESPONSIBILITIES AND AUTHORITIES. g. Any requirement or condition determined by DOE and the contractor to be necessary for safe operation, although more rigorous than the minimum requirements specified in the "basis" documentation described in paragraph 3.e. above may be described in and made a condition of the AA. It should not be inferred, however, that AA restrictions are an acceptable alternative to the use of required SB controls/restrictions and the associated programmatic controls that protect them.						(+) HC-1,2		X
18.03.03.023	DOE LETTER OSQA-15-0081	Encl. 2.3.h.	RESPONSIBILITIES AND AUTHORITIES. h. AAs shall be effective upon the date of signature by both parties and shall expire upon expiration or termination of DOE/SRR Contract. If the implementation of the new/revised AA terms and conditions cannot be accomplished upon the date of signature by both parties, then a period of time shall be stated in the AA authorizing completion of final actions by the facility to implement the terms of the AA. This period of time should typically be on the order of a few days and normally not exceeding 5 calendar days following the effective date of the AA.						(+) HC-1,2		X
18.03.03.024	DOE LETTER OSQA-15-0081	Encl. 2.3.i.	RESPONSIBILITIES AND AUTHORITIES. i. The contractor shall provide for controlled distribution of approved AAs and revisions (when received from DOE) to ensure facility operations personnel and other cognizant personnel (including DOE) are provided with the latest version of the AA in a timely manner. The contractor will coordinate with DOE to obtain a copy of the DOE-approved AAs as soon as practicable after being signed.						(+) HC-1,2		X
18.03.03.025	DOE LETTER OSQA-15-0081	Encl. 2.3.j.	RESPONSIBILITIES AND AUTHORITIES. j. Once implemented as described in (Item i.) above, the contractor shall maintain operations in conformance with the requirements and conditions of the AA.						(+) HC-1,2		X

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18.03.03.026	DOE LETTER OSQA-15-0081	Encl. 2.3.k.	RESPONSIBILITIES AND AUTHORITIES. k. The contractor shall establish provisions to review proposed changes, either physical facility changes, procedure changes, or programmatic changes, to assure the change will not result in noncompliance with a facility AA.						(+) HC-1,2		X
18.03.03.027	DOE LETTER OSQA-15-0081	Encl. 2.3.l.	RESPONSIBILITIES AND AUTHORITIES. l. The contractor shall annually review AAs and, if necessary prepares an update to the AA and submit it to the same review/approval process described above for initial approval. If the conclusion of the review is that no update is necessary, the contractor shall submit a letter to that effect to the cognizant DOE Assistant Manager for the subject facility. The annual AA review/update shall be conducted concurrently with the subject facility annual SB documentation review and USQ Evaluation report, if applicable.						(+) HC-1,2		X
18.03.03.028	DOE LETTER OSQA-15-0081	Encl. 2.3.m.	RESPONSIBILITIES AND AUTHORITIES. m. A revised AA shall be prepared and submitted by the contractor for changes in facility operations that would result in a change in the authorized scope of operation or departure from the terms or conditions of the AA. The revised AA is subject to the same review/approval process described above for initial approval and shall be approved before the change in facility operations is made.						(+) HC-1,2		X
18.03.03.029	DOE LETTER OSQA-15-0081	Encl. 2.3.n.	RESPONSIBILITIES AND AUTHORITIES. n. The "basis" documents described above (such as DSAs, BIOs, TSRs, S/RID, EPHA, RWMB, and others) shall be referenced in the AA such that revisions to the "basis" documents do not automatically require the AA to be revised and re-approved. These documents should be listed by title, followed by the term "latest revision" or "as amended." If applicable, the contractor's controlled SB document list providing the current document revision should be identified. In cases where a new "basis" document is being added, or an existing "basis" document is being cancelled (such as when a new DSA replaces an existing BIO) the contractor's controlled SB document list shall be amended to reflect the revised document set.						(+) HC-1,2		X

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18.03.03.030	DOE LETTER OSQA-15-0081	Encl. 2.3.o.	RESPONSIBILITIES AND AUTHORITIES. o. The contractor shall report noncompliance with AA terms or conditions using existing reporting mechanisms according to the nature of the non-compliance (e.g., Occurrence Reporting and Processing System, Noncompliance Tracking System, Discovery USQ, state notification, etc.). For event classifications that are not applicable to existing guidance, a classification of "Management Concern" shall be used.						(+) HC-1,2		X
18.04.026	10 CFR 830	Sub.B.830.205(a)(1)	Technical safety requirements. A contractor responsible for a hazard category 1, 2, or 3 DOE nuclear facility must: Develop technical safety requirements that are derived from the documented safety analysis. Note: 10 CFR 830, Subpart B, Appendix A, Table 4 sets forth DOE's expectations concerning acceptable Technical Safety Requirements. For Table 4 of Appendix A see S/RID FA 00.	X						X	
18.04.027	10 CFR 830	Sub.B.830.205(a)(2)	Technical safety requirements. A contractor responsible for a hazard category 1, 2, or 3 DOE nuclear facility must: Prior to use, obtain DOE approval of technical safety requirements and any change to technical safety requirements.	X						X	
18.04.028	10 CFR 830	Sub.B.830.205(a)(3)	Technical safety requirements. A contractor responsible for a hazard category 1, 2, or 3 DOE nuclear facility must: Notify DOE of any violation of a technical safety requirement.	X						X	
18.04.029	10 CFR 830	Sub.B.830.205(b)	Technical safety requirements. A contractor may take emergency actions that depart from an approved technical safety requirement when no actions consistent with the technical safety requirement are immediately apparent, and when these actions are needed to protect workers, the public or the environment from imminent and significant harm. Such actions must be approved by a certified operator for a reactor or by a person in authority as designated in the technical safety requirements for nonreactor nuclear facilities. The contractor must report the emergency actions to DOE as soon as practicable.	X						X	

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18.04.030	10 CFR 830	Sub.B.830.205(c)(1)	Technical safety requirements. A contractor for an environmental restoration activity may follow the provisions of 29 CFR 1910.120 or 1926.65 to develop the appropriate hazard controls [rather than the provisions for technical safety requirements in paragraph (a) of this section], provided the activity involves either: Work not done within a permanent structure.	X						X	
18.04.031	10 CFR 830	Sub.B.830.205(c)(2)	Technical safety requirements. A contractor for an environmental restoration activity may follow the provisions of 29 CFR 1910.120 or 1926.65 to develop the appropriate hazard controls [rather than the provisions for technical safety requirements in paragraph (a) of this section], provided the activity involves either: The decommissioning of a facility with only low-level residual fixed radioactivity. Note: Paragraph (a) is included in this Functional Area as Requirements 18.04.026 through 18.04.028.	X						X	
18.05.047	10 CFR 830	Sub.B.830.203(a)	The contractor responsible for a hazard category 1, 2, or 3 DOE nuclear facility must establish, implement, and take actions consistent with a USQ process that meets the requirements of this section.	X						X	
18.05.048	10 CFR 830	Sub.B.830.203(b)	Unreviewed safety question process. The contractor responsible for a hazard category 1, 2, or 3 DOE existing nuclear facility must submit for DOE approval a procedure for its USQ process by April 10, 2001. Pending DOE approval of the USQ procedure, the contractor must continue to use its existing, USQ procedure. If the existing procedure already meets the requirements of this section, the contractor must notify DOE by April 10, 2001 and request that DOE issue an approval of the existing procedure.	X						X	
18.05.049	10 CFR 830	Sub.B.830.203(c)	Unreviewed safety question process. The contractor responsible for a hazard category 1, 2, or 3 DOE new nuclear facility must submit for DOE approval a procedure for its USQ process on a schedule that allows DOE approval in a safety evaluation report issued pursuant to section 207(d) of this Part. Note: Section 207(d) is included in this Functional Area as Requirement 18.03.01.070.	X						X	
18.05.050	10 CFR 830	Sub.B.830.203(d)(1)	Unreviewed safety question process. The contractor responsible for a hazard category 1, 2, or 3 DOE nuclear facility must implement the DOE-approved USQ procedure in situations where there is a: Temporary or permanent change in the facility as described in the existing documented safety analysis.	X						X	

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18.05.051	10 CFR 830	Sub.B.830.203(d)(2)	Unreviewed safety question process. The contractor responsible for a hazard category 1, 2, or 3 DOE nuclear facility must implement the DOE-approved USQ procedure in situations where there is a: Temporary or permanent change in the procedures as described in the existing documented safety analysis.	X						X	
18.05.052	10 CFR 830	Sub.B.830.203(d)(3)	Unreviewed safety question process. The contractor responsible for a hazard category 1, 2, or 3 DOE nuclear facility must implement the DOE-approved USQ procedure in situations where there is a: Test or experiment not described in the existing documented safety analysis.	X						X	
18.05.053	10 CFR 830	Sub.B.830.203(d)(4)	Unreviewed safety question process. The contractor responsible for a hazard category 1, 2, or 3 DOE nuclear facility must implement the DOE-approved USQ procedure in situations where there is a: Potential inadequacy of the documented safety analysis because the analysis potentially may not be bounding or may be otherwise inadequate.	X						X	
18.05.054	10 CFR 830	Sub.B.830.203(e)	Unreviewed safety question process. A contractor responsible for a hazard category 1, 2, or 3 DOE nuclear facility must obtain DOE approval prior to taking any action determined to involve a USQ.	X						X	
18.05.055	10 CFR 830	Sub.B.830.203(f)	Unreviewed safety question process. The contractor responsible for a hazard category 1, 2, or 3 DOE nuclear facility must annually submit to DOE a summary of the USQ determinations performed since the prior submission.	X						X	
18.05.056	10 CFR 830	Sub.B.830.203(g)(1)	Unreviewed safety question process. If a contractor responsible for a hazard category 1, 2, or 3 DOE nuclear facility discovers or is made aware of a potential inadequacy of the documented safety analysis, it must: Take action, as appropriate, to place or maintain the facility in a safe condition until an evaluation of the safety of the situation is completed.	X						X	
18.05.057	10 CFR 830	Sub.B.830.203(g)(2)	Unreviewed safety question process. If a contractor responsible for a hazard category 1, 2, or 3 DOE nuclear facility discovers or is made aware of a potential inadequacy of the documented safety analysis, it must: Notify DOE of the situation.	X						X	

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18.05.058	10 CFR 830	Sub.B.830.203(g)(3)	Unreviewed safety question process. If a contractor responsible for a hazard category 1, 2, or 3 DOE nuclear facility discovers or is made aware of a potential inadequacy of the documented safety analysis, it must: Perform a USQ determination and notify DOE promptly of the results.	X						X	
18.05.059	10 CFR 830	Sub.B.830.203(g)(4)	Unreviewed safety question process. If a contractor responsible for a hazard category 1, 2, or 3 DOE nuclear facility discovers or is made aware of a potential inadequacy of the documented safety analysis, it must: Submit the evaluation of the safety of the situation to DOE prior to removing any operational restrictions initiated to meet paragraph (g)(1) of this section.	X						X	
18.06.001	DOEO420.1C	Att. 2.Ch. III.1	1. OBJECTIVES. To establish requirements for developing and implementing nuclear criticality safety programs (CSPs) for nuclear facilities and activities, including materials transportation activities, which provide adequate protection to the public, workers, and the environment.						(+) CRIT FACILITIES	X	
18.06.002	DOEO420.1C	Att. 2.Ch. III.2	2. APPLICABILITY. This chapter is applicable to DOE elements and DOE contractors with responsibility for nuclear facilities and activities that involve or will potentially involve radionuclides in such quantities that are equal to or greater than the single parameter limits for fissionable materials listed in ANSI/ANS-8.1-2014, Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors, and ANSI/ANS-8.15-**2014**, Nuclear Criticality Control of Special Actinide Elements. These limits must be adjusted where process conditions could credibly involve moderators or reflectors that are more effective than light water.						(+) CRIT FACILITIES	X	
18.06.003	DOEO420.1C	Att. 2.Ch. III.3.a.	3. REQUIREMENTS. a. CSP document must be developed and maintained that describes how the contractor will implement the requirements in this chapter, including the standards invoked by this chapter.						(+) CRIT FACILITIES	X	
18.06.004	DOEO420.1C	Att. 2.Ch. III.3.b.	3. REQUIREMENTS. b. The CSP document must describe how the contractor will satisfy the requirements of the ANSI/ANS-8 series of nuclear criticality safety standards that are in effect as of the date of this Order, unless otherwise modified or approved by DOE **Head of Field Element**. The CSP document must include an explanation as to why any recommendation in applicable ANSI/ANS-8 standards is not implemented.						(+) CRIT FACILITIES	X	

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				Nuclear HC-1,2,3	Radi-ological	High Hazard Chemical	Low Hazard Chemical	Other Industrial	Facility Specific	Common	Facility Specific
18.06.005	DOEO420.1C	Att. 2.Ch. III.3.c.	3. REQUIREMENTS. c. The CSP document must be submitted to and approved by DOE **Head of Field Element.**						(+) CRIT FACILITIES	X	
18.06.006	DOEO420.1C	Att. 2.Ch. III.3.d.	3. REQUIREMENTS. d. Criticality safety evaluations must be conducted in accordance with DOE-STD-3007-**2017**, Guidelines for Preparing Criticality Safety Evaluations at Department of Energy Non-Reactor Nuclear Facilities, or by other documented methods approved by **DOE Head of Field Element.**						(+) CRIT FACILITIES	X	
18.06.007	DOEO420.1C	Att. 2.Ch. III.3.e.	3. REQUIREMENTS. e. Fissile Material Accumulation Control. 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. The following national standards provide relevant guidance for procedure development: ASTM C1455-**14e1,** Standard Test Method for Nondestructive Assay of Special Nuclear Material Holdup Using Gamma-Ray Spectroscopic Methods; and any other nondestructive assay consensus or DOE standards applicable to the measurement technique selected.						(+) CRIT FACILITIES	X	
18.06.008	DOEO420.1C	Att. 2.Ch. III.3.f.	3. REQUIREMENTS. f. Criticality safety evaluations must show that entire processes involving fissionable materials will remain subcritical under normal and credible abnormal conditions, including those initiated by design basis events.						(+) CRIT FACILITIES	X	
18.06.009	DOEO420.1C	Att. 2.Ch. III.3.g.	3. REQUIREMENTS. g. The criteria and process for developing the guidelines for fire fighting in areas within or adjacent to moderator-controlled areas must be coordinated with fire fighting pre-incident plans and procedures.						(+) CRIT FACILITIES	X	
18.06.051	ANS 8.1	4.1.1[1]	Responsibilities. Management shall clearly establish responsibility for nuclear criticality safety. Supervision should be made as responsible for nuclear criticality safety as for production, development, research, or other functions. Each individual, regardless of position, shall be made aware that nuclear criticality safety in his or her work area is ultimately his or her responsibility. This may be accomplished through training and periodic retraining of all operating and support personnel. Guidance for the training of personnel is contained in ANSI/ANS-8.20-1991 (R2005). Nuclear criticality safety differs in no intrinsic way from industrial safety, and good managerial practices apply to both.						(+) CRIT FACILITIES	X	

TABLE 1 - S/RID FUNCTIONAL AREA 18 (NUCLEAR AND PROCESS SAFETY) REQUIREMENTS

S/RID Requirement Number	Source Document	Source Document Reqt Number	Requirement Text	SRR Applicability						Phase I Compliance	
				Nuclear HC-1,2,3	Radi-ological	High Hazard Chemical	Low Hazard Chemical	Other Industrial	Facility Specific	Common	Facility Specific
18.06.052	ANS 8.1	4.1.1[2]	Management shall provide personnel skilled in the interpretation of data pertinent to nuclear criticality safety and familiar with operations to serve as advisors to supervision. These specialists should be, to the extent practicable, administratively independent of process supervisors.						(+) CRIT FACILITIES	X	
18.06.053	ANS 8.1	4.1.1[3]	Management shall establish criteria to be satisfied by nuclear criticality safety controls. Distinction may be made between shielded and unshielded facilities, and the criteria may be less stringent when adequate shielding and confinement assure protection of personnel.						(+) CRIT FACILITIES	X	
18.06.054	ANS 8.1	4.1.2	Process Analysis. Before a new operation is begun or an existing operation is changed, it shall be determined that the entire process will be subcritical under both normal and credible abnormal conditions.						(+) CRIT FACILITIES	X	
18.06.055	ANS 8.1	4.1.3	Written Procedures. Operations to which criticality safety is pertinent shall be governed by written procedures. All persons participating in these operations shall understand and be familiar with the procedures. The procedures shall specify all parameters they are intended to control. The procedures should be such that no single, inadvertent departure from a procedure can cause a criticality accident.						(+) CRIT FACILITIES	X	
18.06.056	ANS 8.1	4.1.4	Materials Control. The movement of fissionable materials shall be controlled. Appropriate materials labeling and posting shall be maintained specifying material identification and all limits on parameters that are subjected to procedural control.						(+) CRIT FACILITIES	X	
18.06.057	ANS 8.1	4.1.5	Operational Control. Deviations from procedures and unforeseen alterations in process conditions that affect nuclear criticality safety shall be reported to management and shall be investigated promptly. Actions shall be taken to prevent a recurrence.						(+) CRIT FACILITIES	X	
18.06.058	ANS 8.1	4.1.6	Operational Reviews. Operations shall be reviewed frequently (at least annually) to ascertain that procedures are being followed and that process conditions have not been altered so as to affect the applicable nuclear criticality evaluation. These reviews shall be conducted, in consultation with operating personnel, by individuals who are knowledgeable in nuclear criticality safety and who, to the extent practicable, are not immediately responsible for the operation.						(+) CRIT FACILITIES	X	
18.06.059	ANS 8.1	4.1.7	Emergency Procedures. Emergency procedures shall be prepared and approved by management. Onsite and off site organizations that are expected to respond to emergencies shall be made aware of conditions that might be encountered, and they should be assisted in preparing suitable procedures governing their responses.						(+) CRIT FACILITIES	X	
18.06.060	ANS 8.1	4.2	Technical Practices. Nuclear criticality safety is achieved by controlling one or more parameters of the system within subcritical limits and by allowances for process contingencies.						(+) CRIT FACILITIES	X	

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18.06.061	ANS 8.1	4.2.1	Controlled Parameters. All controlled parameters and their limits shall be specified. The influence of variations in these parameters on the k-eff of the system shall be understood.						(+) CRIT FACILITIES	X	
18.06.062	ANS 8.1	4.2.2	Double Contingency Principle. Process designs should incorporate sufficient factors of safety to require at least two unlikely, independent, and concurrent changes in process conditions before a criticality accident is possible.						(+) CRIT FACILITIES	X	
18.06.063	ANS 8.1	4.2.3	Geometry Control. Where practicable, reliance should be placed on equipment design in which dimensions are limited rather than on administrative controls. Full advantage may be taken of any nuclear characteristics of the process materials and equipment. All dimensions and nuclear properties on which reliance is placed shall be verified prior to the beginning of operations, and control shall be exercised to maintain them.						(+) CRIT FACILITIES	X	
18.06.064	ANS 8.1	4.2.4	Neutron Absorbers. Reliance may be placed on neutron absorbing materials, such as cadmium and boron, that are incorporated in process materials or in equipment, or in both. Control shall be exercised to maintain their continued presence with the intended distributions and concentrations. Care should be taken with solutions of absorbers because of the difficulty of exercising such control.						(+) CRIT FACILITIES	X	
18.06.065	ANS 8.1	4.2.7	Subcritical Limit. Where applicable data are available, subcritical limits shall be established on bases derived from experiments, with adequate allowance for uncertainties in the data. In the absence of directly applicable experimental measurements, the limits may be derived from calculations made by a method shown by comparison with experimental data to be valid in accordance with 4.3. Note: The requirement of 4.3 is included in this Functional area as Requirements 18.06.066 and points to ANS 8.24 for requirements. Those requirements are found in 18.06.801 through 18.06.826.						(+) CRIT FACILITIES	X	

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18.06.066	ANS 8.1	4.3	4.3 Validation of a calculational method Validation shall be performed by comparison to critical and exponential experiments, and the area of applicability for the validation should be established from this comparison. There are many calculational methods suitable for determining the subcritical state of a system. The methods vary widely in basis and form, and each has its place in the broad spectrum of situations encountered in the nuclear criticality safety field. The validity of any method used to determine the subcritical state of a fissionable material system shall be established. The general procedure to be followed in establishing validity is common to all. Guidance for the validation of neutron transport methods for nuclear criticality safety calculations is contained in ANS 8.24 (R2012). The applicable technical requirements and recommendations in that standard (e.g., establishment of bias, trending, and applicability) may be adapted for other calculational methods with technical justification. Note: ANS 8.24 is found in this Functional Area as Requirements 18.06.801 through 18.06.826. **ANS 8.24 (R2012) has been replaced by the 2017 version.**						(+) CRIT FACILITIES	X	
18.06.067	ANS 8.1	5.[1]	Operations with fissile materials can be performed safely by complying with any one of the limits given in Sections 5.1 through 5.4 for single units of U-233, U-235, and plutonium, provided the conditions under which the limit applies are maintained; these limits were calculated by methods satisfying the requirements in Section 4.3. Guidance for other fissionable isotopes is contained in ANS 8.15 (R2005). Such subcritical limits shall be applied only when surrounding materials, including other nearby fissionable materials, can be shown to increase the k-eff no more than it would be increased if the unit were enclosed by a contiguous layer of water of unlimited thickness. A limit may be applied to a mixture of fissile nuclides by considering all components of the mixture to be the one with the most restrictive limit. Notes: 1. For Sections 5.1 to 5.4, see the Source Document. 2. The requirement of 4.3 is included in this Functional Area as requirement 18.06.066, and points to ANS 8.24 for requirements. Those requirements are found in 18.06.801 through 18.06.826. 3. ANS 8.15 is found in this Functional Area as Requirements 18.06.401 through 18.06.403.						(+) CRIT FACILITIES	X	

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S/RID Requirement Number	Source Document	Source Document Reqt Number	Requirement Text	SRR Applicability						Phase I Compliance	
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18.06.068	ANS 8.1	5.[2]	Process specifications shall incorporate margins to protect against uncertainties in process variables and against a limit being accidentally exceeded.						(+) CRIT FACILITIES	X	
18.06.069	ANS 8.1	6.	Simultaneous limitation of two or more parameters results in a less restrictive limit for the one of interest. A few particularly useful examples are given in Sections 6.1 through 6.4. All were calculated by methods satisfying the requirements in Section 4.3. These subcritical limits shall be applied only when the surrounding materials can be shown to increase k-eff no more than it would be increased if the unit were enclosed by a contiguous layer of water of unlimited thickness. Process specifications shall incorporate margins to protect against uncertainties in process variables and against a limit being accidentally exceeded. Notes: 1. For Sections 6.1 to 6.4, see the Source Document. 2. The requirement of 4.3 is included in this Functional Area as requirement 18.06.066, and points to ANS 8.24 for requirements. Those requirements are found in 18.06.801 through 18.06.826.						(+) CRIT FACILITIES	X	
18.06.101	ANS 8.3	4.1.1	Installation of an alarm system implies a nontrivial risk of criticality. Where alarms are installed, emergency procedures shall be maintained. Guidance for the preparation of emergency plans is provided in American National Standard, Administrative Practices for Nuclear Criticality Safety, ANS 8.19. Note: ANS 8.19 is found in this Functional Area as Requirements 18.06.501 through 18.06.546.						(+) CRIT FACILITIES	X	
18.06.102	ANS 8.3	4.1.2	Process equipment used in areas from which immediate evacuation is required Should be so designed that leaving the equipment will not introduce significant risk.						(+) CRIT FACILITIES	X	
18.06.103	ANS 8.3	4.1.3	The purpose of an alarm system is to reduce risk to personnel. Evaluation of the overall risk should recognize that hazards may result from false alarms and subsequent sudden interruption of operations and relocation of personnel.						(+) CRIT FACILITIES	X	

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				Nuclear HC-1,2,3	Radi-ological	High Hazard Chemical	Low Hazard Chemical	Other Industrial	Facility Specific	Common	Facility Specific
18.06.104	ANS 8.3	4.2.1	The need for criticality alarm systems shall be evaluated for all activities in which the inventory of fissionable materials in individual unrelated areas exceeds 700 g of U-235, 500 g of U-233, 450 g of Pu-239, or 450 g of any combination of these three isotopes. For operations involving significant quantities of other fissionable isotopes, this evaluation shall be made whenever quantities exceed the subcritical mass limits specified in American National Standard Nuclear Criticality Control of Special Actinide Elements, ANSI/ANS-8.15-1981. Also, this evaluation shall be made for all processes in which neutron moderators or reflectors more effective than water are present, or unique material configurations exist such that critical mass requirements may be less than the typical subcritical mass limits noted above. For this evaluation, individual areas may be considered unrelated when the boundaries between the areas are such that there can be no uncontrolled transfer of materials between areas, the minimum separation between material in adjacent areas is 10 cm, and the areal density of the fissionable material averaged over each individual area is less than 50 g per square meter. This stipulation is applicable only to the three specific isotopes noted above (U-235, U-233, and Pu-239). Note: ANSI/ANS-8.15 is included in this Functional Area as Requirements 18.06.401-18.06.403.						(+) CRIT FACILITIES	X	
18.06.105	ANS 8.3	4.2.2	A criticality alarm system meeting the requirements of this standard shall be installed in areas where personnel would be subject to an excessive radiation dose. For this purpose, the maximum fission yield integrated over the duration of the accident may be assumed not to exceed 2.0 x 10 exponent 19 fissions. The basis for a different maximum yield shall be documented. If criticality accidents of lesser magnitude than the minimum accident of concern given in 5.6 are of concern, then other detection methods (e.g., audible personnel dosimetry) should be considered. These other detection methods are not considered as criticality accident alarm systems and are not covered by this standard. Note: Section 5.6 is provided as S/RID requirement 18.06.124 in this Functional Area.						(+) CRIT FACILITIES	X	
18.06.106	ANS 8.3	4.2.3	In areas in which criticality alarm coverage is required, a means shall be provided to detect a criticality accident and to signal that prompt protective action is required.						(+) CRIT FACILITIES	X	

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				Nuclear HC-1,2,3	Radi-ological	High Hazard Chemical	Low Hazard Chemical	Other Industrial	Facility Specific	Common	Facility Specific
18.06.107	ANS 8.3	4.3.1	Criticality alarm signals shall be for prompt evacuation or other protective actions. The criticality alarm signals should be uniform throughout the system. The signal shall be distinctive from other signals or alarms which require a response different from that necessary in the event of a criticality accident.						(+) CRIT FACILITIES	X	
18.06.108	ANS 8.3	4.3.2	The signal generators shall be automatically and promptly actuated upon detection of a criticality accident.						(+) CRIT FACILITIES	X	
18.06.109	ANS 8.3	4.3.3	After actuation, the signal generators shall continue to function as required by emergency procedures, even if the radiation falls below the alarm point. Manual resets, with limited access, should be provided outside areas that require evacuation.						(+) CRIT FACILITIES	X	
18.06.110	ANS 8.3	4.3.4	A means for manual actuation of the criticality alarm signal may be provided.						(+) CRIT FACILITIES	X	
18.06.111	ANS 8.3	4.3.5	For all occupied areas where personnel protective action is required in the event of criticality accident detection, the number and placement of criticality alarm signal generators shall be such that the signals are adequate to notify personnel promptly throughout those areas.						(+) CRIT FACILITIES	X	
18.06.112	ANS 8.3	4.3.6	The audio generators should produce an overall sound pressure level of at least 75dB, but not less than 10 dB above the maximum ambient noise level typical of each area for which audio coverage is to be provided.						(+) CRIT FACILITIES	X	
18.06.113	ANS 8.3	4.3.7	Because excessive noise levels can be injurious to personnel, the audio generators should not produce an A-weighted sound level in excess of 115 dB at the ear of an individual.						(+) CRIT FACILITIES	X	
18.06.114	ANS 8.3	4.3.8	In areas with high audio background or mandatory hearing protection, visual signals or other alarm means should be considered.						(+) CRIT FACILITIES	X	
18.06.115	ANS 8.3	4.4.1	Consideration shall be given to the avoidance of false alarms. This may be accompanied by providing reliable single detector channels or by requiring concurrent response of two or more detectors to initiate the alarm. In redundant systems, failure of any single channel shall not prevent compliance with the detection criterion specified in 5.6. Note: Section 5.6 is provided as S/RID requirement 18.06.124 in this Functional Area.						(+) CRIT FACILITIES	X	
18.06.116	ANS 8.3	4.4.2	Portable instruments may be used in special situations to augment an installed criticality accident alarm system. Examples of such situations include alarm system maintenance or testing, evacuation drills, activities in areas not normally occupied by personnel, or other special operations. Where portable instruments are used to meet the intent of this standard, the usage shall be evaluated to determine appropriate criteria of this standard. Criteria for such use of portable instruments shall be specified in procedures.						(+) CRIT FACILITIES	X	

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18.06.117	ANS 8.3	4.4.3	Process areas in which activities will continue during power outages shall have emergency power supplied for alarm systems, or such activities shall be monitored continuously with portable instruments.						(+) CRIT FACILITIES	X	
18.06.118	ANS 8.3	4.4.4	Adequate sensitivity of the alarm system to respond to the minimum accident of concern is addressed in 5.6. The system shall be sufficiently robust as to actuate the alarm signal when exposed to the maximum radiation expected. Note: Section 5.6 is provided as S/RID requirement 18.06.124 in this Functional Area.						(+) CRIT FACILITIES	X	
18.06.119	ANS 8.3	5.1	Reliability. The system shall be designed for high reliability and should utilize components that do not require frequent servicing such as lubrication or cleaning. The system should be designed to minimize the effects of nonuse, deterioration, power surges, and other adverse conditions. The design of the system should be as simple as is consistent with the objectives of ensuring reliable actuation of the criticality alarm signal and avoidance of false alarms.						(+) CRIT FACILITIES	X	
18.06.120	ANS 8.3	5.2	System Vulnerability. All components of the system should be located to minimize damage in case of fire, explosion, corrosive atmosphere, and other extreme conditions. The system should be designed to minimize the potential for failure, including false alarms, due to human error.						(+) CRIT FACILITIES	X	
18.06.121	ANS 8.3	5.3	Seismic Tolerance. The system should remain operational in the event of seismic shock equivalent to the site specific design basis earthquake, or the equivalent value specified by the Uniform Building Code, that applies to the structure.						(+) CRIT FACILITIES	X	
18.06.122	ANS 8.3	5.4	Failure Warning. The system should be designed to provide a visible or audible warning signal at some normally occupied location to indicate system malfunction or loss of primary power.						(+) CRIT FACILITIES	X	
18.06.123	ANS 8.3	5.5	Response Time. The system shall be designed to produce the criticality alarm signal within one-half second of detector recognition of a criticality accident.						(+) CRIT FACILITIES	X	
18.06.124	ANS 8.3	5.6	Detection Criterion. Criticality alarm systems shall be designed to detect immediately the minimum accident of concern. For this purpose, in areas where material is handled or processed with only nominal shielding, the minimum accident may be assumed to deliver the equivalent of an absorbed dose in free air of 0.2 Gy/min (20 rad/min) 2 m from the reacting material. The basis for a different minimum accident of concern shall be documented.						(+) CRIT FACILITIES	X	
18.06.125	ANS 8.3	5.7.1	Criticality alarm systems shall be designed so that alarm actuation shall occur as a result of the minimum duration transient. It may be assumed that the minimum duration of the radiation transient is 1 msec.						(+) CRIT FACILITIES	X	

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18.06.126	ANS 8.3	5.7.2	The alarm trip point should be set high enough to minimize the probability of an alarm from sources other than criticality. The level shall be set low enough to detect the minimum accident of concern.						(+) CRIT FACILITIES	X	
18.06.127	ANS 8.3	5.8	Spacing. The spacing of detectors shall be consistent with the selected alarm trip point and with the detection criterion. The location and spacing of detectors should be chosen to minimize the effect of shielding by massive equipment or materials. Shielding from low density materials of construction, such as wood framing, thin interior walls, hollow brick tiles, etc. may be disregarded.						(+) CRIT FACILITIES	X	
18.06.128	ANS 8.3	6.1	Initial Tests. Initial tests, inspections and checks of the system shall verify that the fabrication and installation were made in accordance with design plans and specifications.						(+) CRIT FACILITIES	X	
18.06.129	ANS 8.3	6.2	Special Tests. Following modifications or repairs, or events which call the system performance into question, there shall be tests and inspections adequate to demonstrate system operability.						(+) CRIT FACILITIES	X	
18.06.130	ANS 8.3	6.3	Response to Radiation. System response to radiation shall be measured periodically to confirm continuing instrument performance. The test interval should be determined on the basis of experience. In the absence of experience, tests should be performed at least monthly. Records of tests shall be maintained. System designs may incorporate self-checking features to automate portions of this testing.						(+) CRIT FACILITIES	X	
18.06.131	ANS 8.3	6.4	Periodic Tests. The entire alarm system shall be tested periodically. Each signal generator should be tested at least annually. Field observations shall establish that criticality alarm signals are functional throughout all areas where personnel could be subject to an excessive radiation dose. All personnel in the affected area shall be notified before testing of the criticality alarm signals.						(+) CRIT FACILITIES	X	
18.06.132	ANS 8.3	6.5	Corrective Action. When tests reveal inadequate performance, corrective action shall be taken without unnecessary delay. If portable instrument use is required, the criteria of 4.4.2 shall be met.						(+) CRIT FACILITIES	X	
18.06.133	ANS 8.3	6.6	Test Procedures. Procedures for system testing shall minimize both false alarms and inadvertent initiation of emergency response. The procedures shall also require that the systems be returned to normal operation immediately following tests.						(+) CRIT FACILITIES	X	
18.06.134	ANS 8.3	6.7	Records. Records of tests and corrective actions for each system shall be maintained. These records provide information on system operability and help identify sources of failure.						(+) CRIT FACILITIES	X	
18.06.135	ANS 8.3	7.1	Posted Instructions. Instructions regarding response to criticality alarm signals shall be posted at strategic locations within areas requiring alarm coverage.						(+) CRIT FACILITIES	X	

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18.06.151	ANS 8.6	4.1	A written procedure for each new in situ experiment shall be prepared and reviewed in a manner approved by management. Primary responsibility for safety shall be assigned to one individual experienced in the performance of subcritical or critical experiments. Another experienced experimenter shall review the procedure.						(+) CRIT FACILITIES	X	
18.06.152	ANS 8.6	4.2	The written procedure shall be reviewed by all who are expected to take part in the experiment.						(+) CRIT FACILITIES	X	
18.06.153	ANS 8.6	4.3	At least two persons shall be present during an experiment.						(+) CRIT FACILITIES	X	
18.06.154	ANS 8.6	4.4	A record of the status and progress of the experiment shall be maintained with particular emphasis on safety.						(+) CRIT FACILITIES	X	
18.06.155	ANS 8.6	4.5	Emergency procedures and radiation detection instrumentation appropriate to the experiment shall be provided.						(+) CRIT FACILITIES	X	
18.06.156	ANS 8.6	5.1	The mechanical integrity of equipment to be used in conjunction with the fissile assembly shall be verified prior to the experiment.						(+) CRIT FACILITIES	X	
18.06.157	ANS 8.6	5.2	The proper functioning of all counting circuits, neutron- and gamma-ray-sensing devices, alarms, and necessary instrumentation shall be verified prior to the experiment.						(+) CRIT FACILITIES	X	
18.06.158	ANS 8.6	5.3	A source of neutrons shall be present to produce a meaningful indication of neutron multiplication. This source may be inherent in the fissile assembly, e.g., neutrons from spontaneous fission or from (alpha, neutron) reactions. Note: The symbols for alpha and neutron have been translated.						(+) CRIT FACILITIES	X	
18.06.159	ANS 8.6	5.4	At least two independent neutron-sensitive counting devices shall monitor the neutron population in the fissile assembly under investigation.						(+) CRIT FACILITIES	X	
18.06.160	ANS 8.6	5.5	A signal continuously indicative of the neutron level shall be audible and may be supplemented by an otherwise apparent signal such as a flashing light.						(+) CRIT FACILITIES	X	
18.06.161	ANS 8.6	6.1	If anyone participating in the experiment expresses doubt of the safety of a particular action or step, the experiment shall be suspended until the doubt is resolved.						(+) CRIT FACILITIES	X	
18.06.162	ANS 8.6	6.2	The cause of any unexpected behavior of the assembly and its associated equipment or of any peculiarity in the resulting data shall be resolved before further reactivity additions						(+) CRIT FACILITIES	X	

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18.06.163	ANS 8.6	6.3	A reactivity limit for the fissile assembly shall be defined in the written procedure. The limit may be stated in terms of a maximum value of neutron multiplication or of a fraction of an estimated critical mass, volume, or dimension. The margin below criticality shall be commensurate with experimental uncertainties; allowance shall be made for effects of neutron reflection brought about by personnel or other movable objects.						(+) CRIT FACILITIES	X	
18.06.164	ANS 8.6	6.4	Plots of reciprocal neutron multiplication as a function of the parameter identifying reactivity change shall be maintained independently by at least two persons using data from two or more neutron-detector channels. These plots shall have sufficient number of points to permit meaningful extrapolation.						(+) CRIT FACILITIES	X	
18.06.165	ANS 8.6	6.5	The magnitude of reactivity additions shall be guided by extrapolation of the plots of reciprocal neutron multiplication and shall be such that the limit defined in 6.3 is not exceeded. Caution is recommended in the interpretation of reciprocal neutron multiplication curves; typical experimental curves are discussed in Chapter 5 of Thompson and Beckerley. Note: Section 6.3 is provided as S/RID requirement 18.06.163 in this Functional Area.						(+) CRIT FACILITIES	X	
18.06.166	ANS 8.6	6.6	Every addition of reactivity shall be authorized by the person assigned primary responsibility for safety in accordance with 4.1. Note: Section 4.1 is provided as S/RID requirement 18.06.151 in this Functional Area.						(+) CRIT FACILITIES	X	
18.06.167	ANS 8.6	6.7	No reactivity addition shall be made until the effects of preceding additions have been evaluated and until the response to be expected from the subsequent addition has been estimated.						(+) CRIT FACILITIES	X	
18.06.168	ANS 8.6	6.8	Reactivity additions shall not be made simultaneously by more than one method.						(+) CRIT FACILITIES	X	
18.06.169	ANS 8.6	6.9	Alteration in the method of reactivity addition shall not be such as to invalidate the extrapolation of the plot of reciprocal multiplication.						(+) CRIT FACILITIES	X	
18.06.170	ANS 8.6	6.10	Consideration shall be given to the possibility of inadvertent reactivity additions such as might occur from the instability of slurries, from collapse or formation of voids, from inadvertent transfer of material, of from other conditions.						(+) CRIT FACILITIES	X	
18.06.171	ANS 8.6	6.11	Placement of source and detectors shall be such that the neutrons observed are predominantly those produced by the fissile assembly.						(+) CRIT FACILITIES	X	

TABLE 1 - S/RID FUNCTIONAL AREA 18 (NUCLEAR AND PROCESS SAFETY) REQUIREMENTS

S/RID Requirement Number	Source Document	Source Document Reqt Number	Requirement Text	SRR Applicability						Phase I Compliance	
				Nuclear HC-1,2,3	Radi-ological	High Hazard Chemical	Low Hazard Chemical	Other Industrial	Facility Specific	Common	Facility Specific
18.06.172	ANS 8.6	6.12	If a neutron source or detector is to be moved from one location to another, or if attenuating material is to be inserted between that source and detectors, the effect on neutron counting rate of such change shall be measured before further reactivity addition.						(+) CRIT FACILITIES	X	
18.06.173	ANS 8.6	6.13	Changing the spacing between elements of an array should not be the means of changing reactivity. Data from reciprocal multiplication plots obtained from separate experiments with different spacing may be used to evaluate the effect of element spacing on neutron multiplication.						(+) CRIT FACILITIES	X	
18.06.201	ANS 8.7	4.1.1	All operations with fissile material, including storage, shall be conducted in accordance with ANS-8.1. This standard is intended to supplement ANS-8.1 by providing storage criteria applicable to many fissile materials.						(+) CRIT FACILITIES	X	
18.06.202	ANS 8.7	4.1.2	Methods of storage control and operational practices approved by management shall be described in written procedures. Persons participating in the transfer and storage of material shall be familiar with these procedures. Limits for storage shall be posted.						(+) CRIT FACILITIES	X	
18.06.203	ANS 8.7	4.1.3	Management shall provide for inspections (of storage areas) to verify compliance with established procedures.						(+) CRIT FACILITIES	X	
18.06.204	ANS 8.7	4.1.4	Access to storage areas shall be controlled.						(+) CRIT FACILITIES	X	
18.06.205	ANS 8.7	4.2.1	Limits for the storage of fissile material shall be based on experimental data or the results of validated computational techniques.						(+) CRIT FACILITIES	X	
18.06.206	ANS 8.7	4.2.2	Storage facilities and structures shall be designed, fabricated, and maintained in accordance with good engineering practices.						(+) CRIT FACILITIES	X	
18.06.207	ANS 8.7	4.2.3	The design of storage structures should preclude unacceptable arrangements or configurations, thereby reducing reliance on administrative controls.						(+) CRIT FACILITIES	X	
18.06.208	ANS 8.7	4.2.4	Fissile materials shall be stored in such a way that accidental nuclear criticality resulting from fire or from flood, earthquake, or other natural calamities is not a concern.						(+) CRIT FACILITIES	X	
18.06.209	ANS 8.7	4.2.5	Storage areas should contain essentially no combustible materials. Where the presence of significant quantities of combustibles is unavoidable, as in the storage of combustible scrap, a fire protection system shall be installed.						(+) CRIT FACILITIES	X	
18.06.210	ANS 8.7	4.2.6	Spacing of storage units may be maintained by the use of birdcage fixtures, covered metal cans, or physical barriers on shelves. Shelving shall be sturdy and noncombustible.						(+) CRIT FACILITIES	X	
18.06.211	ANS 8.7	4.2.7	Containers of fissile materials in areas with sprinkler systems shall be designed to prevent the accumulation of water.						(+) CRIT FACILITIES	X	
18.06.212	ANS 8.7	4.2.8	In fissile material storage areas equipped with sprinkler systems, consideration shall be given to the possibility of criticality occurring in an accumulation of runoff water from the sprinkler system.						(+) CRIT FACILITIES	X	

TABLE 1 - S/RID FUNCTIONAL AREA 18 (NUCLEAR AND PROCESS SAFETY) REQUIREMENTS

S/RID Requirement Number	Source Document	Source Document Reqt Number	Requirement Text	SRR Applicability						Phase I Compliance	
				Nuclear HC-1,2,3	Radi-ological	High Hazard Chemical	Low Hazard Chemical	Other Industrial	Facility Specific	Common	Facility Specific
18.06.213	ANS 8.7	4.2.10	Good housekeeping shall be incorporated as an important part of nuclear criticality safety practices.						(+) CRIT FACILITIES	X	
18.06.214	ANS 8.7	5.6	5. Parameters, Limits, and Conditions: Tables 5.1 - 5.11; 6. Other Applications Notes: 1. Per DOE-HQ guidance, 2/17/93, these requirements only apply if ANS 8.7 is the sole source used to determine spacing. Different spacing may be used if calculations are performed or if experimental data are used to make the spacing determination - in which case these ANS 8.7 requirements do not need to be applied. If tables 5.1 - 5.11 are used, then the requirements in Sections 5 and 6 apply. 2. For Tables 5.1 to 5.11 and Section 6, see the Source Document.							X	
18.06.215	ANS 8.7	5.2	Moderation. The ratios of hydrogen to fissile material atoms are determined within the fissile region and do not include contiguous hydrogenous materials. Margins inherent in the mass limits specified are sufficient to compensate for incidental moderation such as that resulting from enclosing each unit in a thin plastic bag. The effects of more significant moderation should be evaluated through the use of a validated computational technique.						(+) CRIT FACILITIES	X	
18.06.216	ANS 8.7	5.5	Double batching shall be considered in storage safety analyses and in the establishment of operating procedures. If double batching is credible, it shall be determined that double batching in a single storage cell will not result in array criticality. Administrative controls, limited capacity containers, and storage cell design may be useful for the prevention of double batching.						(+) CRIT FACILITIES	X	
18.06.251	ANS 8.10	4.1	Criteria for Adequate Shielding and Confinement Conditions. The provisions of this standard may be applied only in those shielded facilities which meet the following criteria: a. All operations and manipulations involving fissile and fissionable materials are conducted remotely by persons located outside the shielded area, and b. Shielding and confinement provided are adequate to meet the radiation dose limits set forth in this section.						(+) CRIT FACILITIES	X	

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				Nuclear HC-1,2,3	Radi-ological	High Hazard Chemical	Low Hazard Chemical	Other Industrial	Facility Specific	Common	Facility Specific
18.06.252	ANS 8.10	4.2.1	Criteria for Adequate Shielding and Confinement Adequacy of Shielding and Confinement. Shielding and confinement are considered adequate when the following conditions would be satisfied during and subsequent to a criticality accident. However, better shielding and confinement are desirable if practical. Radiation Dose. For design evaluation purposes, the radiation source strengths and releases may be estimated by detailed analysis of credible criticality accidents. Appendix A and its references show examples of how this may be accomplished. The shielding and confinement should be such that the total effective dose received by an individual located at any point outside the shielded and confined area will not exceed 10 rem (0.10 Sv) during and subsequent to a criticality accident. In addition, the shielding and confinement should be such that the total effective dose received by an individual outside the restricted area will not exceed 0.5 rem (5 mSv) (Note 1). Note: 1) For purposes of design evaluation for credible criticality accidents, doses stated are five times the ICRP 103 planned special exposure limit for both individual and members of the public.						(+) CRIT FACILITIES	X	
18.06.253	ANS 8.10	4.2.2	Criteria for Adequate Shielding and Confinement Adequacy of Shielding and Confinement. Shielding and confinement are considered adequate when the following conditions would be satisfied during and subsequent to a criticality accident. However, better shielding and confinement are desirable if practical. Shielding and Confinement Criterion. The shielding and confinement system of a facility shall be designed to limit the dose, resulting from exposure to direct radiation and to radionuclides generated by the criticality accident and released from the facility to that specified by Sec. 4.2.1.						(+) CRIT FACILITIES	X	

TABLE 1 - S/RID FUNCTIONAL AREA 18 (NUCLEAR AND PROCESS SAFETY) REQUIREMENTS

S/RID Requirement Number	Source Document	Source Document Reqt Number	Requirement Text	SRR Applicability						Phase I Compliance	
				Nuclear HC-1,2,3	Radi-ological	High Hazard Chemical	Low Hazard Chemical	Other Industrial	Facility Specific	Common	Facility Specific
18.06.254	ANS 8.10	4.2.3	Criteria for Adequate Shielding and Confinement Adequacy of Shielding and Confinement. Shielding and confinement are considered adequate when the following conditions would be satisfied during and subsequent to a criticality accident. However, better shielding and confinement are desirable if practical. Structural Integrity. The shield and confinement system shall be designed to withstand physical damage from credible events and maintain function.						(+) CRIT FACILITIES	X	
18.06.255	ANS 8.10	4.2.4	Criteria for Adequate Shielding and Confinement Adequacy of Shielding and Confinement. Shielding and confinement are considered adequate when the following conditions would be satisfied during and subsequent to a criticality accident. However, better shielding and confinement are desirable if practical. Distance in Lieu of Shielding. If personnel are located remotely from the fissile and fissionable materials, distance may serve in lieu of some or all of the shielding, provided personnel entry into the intervening distance is controlled and the other conditions set forth in 4.2 are met.						(+) CRIT FACILITIES	X	
18.06.256	ANS 8.10	5.0	Criticality Safety Practices Where shielding and confinement were in place, the consequences of previous process criticality accidents have been primarily disruption of processes and related costs. Accordingly, if these consequences are acceptable, an increased likelihood of a criticality accident is acceptable when the consequence to personnel is low due to the facility design. This may be reflected in reduced conservatism in the process analysis. However, plant design and operations are premised on good engineering practices, which dictate that criticality accidents shall not occur under normal and credible abnormal conditions where personnel are at risk.						(+) CRIT FACILITIES	X	

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				Nuclear HC-1,2,3	Radi-ological	High Hazard Chemical	Low Hazard Chemical	Other Industrial	Facility Specific	Common	Facility Specific
18.06.257	ANS 8.10	5.1	Criticality Safety Practices Single contingency operation. The number of unlikely changes in process conditions as detailed in Section 4.2.2 of ANSI/ANS 8.1, Double Contingency Principle, may be reduced to unity when the criteria of this standard are met. Design of operations in which a single unlikely change in process conditions might result in a criticality accident should be kept to a minimum. If criticality accident prevention relies primarily on administrative requirements (e.g., failing to add a neutron absorber or exceeding a mass limit might lead to a criticality accident), then procedures should be written such that no single, inadvertent departure from procedures can cause a criticality accident. Note 1) Section 4.2.2 of ANS-8.1 is included in this Functional Area as Requirement 18.06.062.						(+) CRIT FACILITIES	X	
18.06.258	ANS 8.10	5.2	Criticality Safety Practices Methods for Unshielded Facilities. This standard in no way precludes the application of ANSI/ANS 8.1 to facilities with shielding and confinement. Note: ANS 8.1 is included in this Functional Area as Requirements 18.06.051 through 18.06.069.						(+) CRIT FACILITIES	X	
18.06.301	ANS 8.12	4.2.[1]	Consideration shall be given to the possibility of preferential separation of Pu from U.						(+) CRIT FACILITIES	X	
18.06.351	ANS 8.14	4.1.1	Selection of a soluble neutron absorber shall include assessment of the operating environment and of the chemical compatibility of the neutron absorber with the process for which it is to be used. Consideration shall be given to the solubility of the neutron absorber and to materials and conditions (e.g., temperature and pressure) that could cause precipitation or plate-out of the neutron absorber.						(+) CRIT FACILITIES	X	
18.06.352	ANS 8.14	4.1.2	The soluble neutron absorber shall maintain its minimum required neutron absorption capability during its intended operating life.						(+) CRIT FACILITIES	X	
18.06.353	ANS 8.14	4.1.3	Selection of a soluble neutron absorber shall include an assessment of the absorber effectiveness under credible conditions of neutron moderation and reflection.						(+) CRIT FACILITIES	X	
18.06.354	ANS 8.14	4.1.4	Selection of a neutron absorber shall include evaluation of radiation effects (e.g., depletion by neutron absorption, radiolysis) over its operating life.						(+) CRIT FACILITIES	X	
18.06.355	ANS 8.14	4.1.5	Selection of a soluble neutron absorber shall include evaluation of the requirements of operations and of fissile material accountability.						(+) CRIT FACILITIES	X	
18.06.356	ANS 8.14	4.1.6	Selection of a soluble neutron absorber should include evaluation of the requirements of other safety disciplines.						(+) CRIT FACILITIES	X	

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				Nuclear HC-1,2,3	Radi-ological	High Hazard Chemical	Low Hazard Chemical	Other Industrial	Facility Specific	Common	Facility Specific
18.06.357	ANS 8.14	4.2.1	The following system design requirements and recommendation shall apply to both system design and system modifications. For the range evaluated as subcritical, the system design shall prevent inadvertent concentration of fissile solution and removal or dilution of the neutron absorber.						(+) CRIT FACILITIES	X	
18.06.358	ANS 8.14	4.2.2	The following system design requirements and recommendation shall apply to both system design and system modifications. For the range evaluated as subcritical, the system design shall account for potential degradation of the neutron absorber and the chemicals used to dissolve or stabilize the neutron absorber.						(+) CRIT FACILITIES	X	
18.06.359	ANS 8.14	4.2.3	The following system design requirements and recommendation shall apply to both system design and system modifications. The design of the system equipment incorporating soluble neutron absorbers should incorporate human factors engineering practices for preparation, use, and control of the neutron absorber.						(+) CRIT FACILITIES	X	
18.06.360	ANS 8.14	4.2.4	The following system design requirements and recommendation shall apply to both system design and system modifications. The system design shall consider the need for inspection, sampling, and verification of the adequacy of the neutron absorbing capability prior to use and during the operational lifetime of the neutron absorber.						(+) CRIT FACILITIES	X	
18.06.361	ANS 8.14	4.2.5	The following system design requirements and recommendation shall apply to both system design and system modifications. A means of verification shall be provided to determine that the system design, safety, and operating requirements are met for all operations that utilize soluble neutron absorbers.						(+) CRIT FACILITIES	X	
18.06.362	ANS 8.14	4.3.1	Evaluations shall include allowances for uncertainties in the neutron absorber concentration, distribution, and neutronic properties (i.e., accuracy of neutron cross-section values).						(+) CRIT FACILITIES	X	
18.06.363	ANS 8.14	4.3.2	Evaluations shall include consideration of equipment design tolerances, chemical reaction tolerances, material substitutions, geometry changes, modeling assumptions, process variables, neutron absorber isotopic distribution, and relevant uncertainties.						(+) CRIT FACILITIES	X	
18.06.364	ANS 8.14	4.3.3	Evaluations shall consider the potential for neutron absorber degradation in the normal operating environment due to physical or chemical actions and solution composition changes.						(+) CRIT FACILITIES	X	

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				Nuclear HC-1,2,3	Radi-ological	High Hazard Chemical	Low Hazard Chemical	Other Industrial	Facility Specific	Common	Facility Specific
18.06.365	ANS 8.14	4.3.4	Evaluations shall consider the effect on nuclear criticality safety of potential non-uniform distribution of the neutron absorber.						(+) CRIT FACILITIES	X	
18.06.366	ANS 8.14	4.3.5	Evaluations shall consider the impact on the neutron absorber and subsequent effect on system reactivity of changes to process conditions that lead to adverse environmental and operating conditions ~e.g., radiolysis, chemical reactions, temperature variations, changes in pressure, depletion, and dilution.						(+) CRIT FACILITIES	X	
18.06.367	ANS 8.14	4.3.6	Evaluations shall consider worst-case credible concentrations of both soluble absorber and fissile materials for operations involving the dissolution of fissile material.						(+) CRIT FACILITIES	X	
18.06.368	ANS 8.14	4.3.7	Evaluations shall be based on data from applicable experiments or validated calculations. The calculational methods shall be validated in accordance with ANSI/ANS-8.1-1998. Note: ANS-8.1-1998 has been replaced by ANS-8.1-2014. Validation in ANS-8.1-2014 is found in Section 4.3. The Requirement of 4.3 is included in this Functional Area as Requirement 18.06.066, and points to ANS-8.24 for requirements. Those requirements are found in 18.06.801 through 18.06.826.						(+) CRIT FACILITIES	X	
18.06.369	ANS 8.14	4.4.1	A documented quality control program shall be implemented for soluble neutron absorber acquisition, storage, preparation, and use. The program should conform to the operating facility's quality assurance program. Records of the associated operations shall be maintained for the operating life of the facility.						(+) CRIT FACILITIES	X	
18.06.370	ANS 8.14	4.4.2	The quality control program for soluble neutron absorbers should utilize a combination of inspections, tests, sample analyses, and verifications. Actions taken as a result of the program shall not compromise the nuclear criticality safety of the operating system.						(+) CRIT FACILITIES	X	
18.06.371	ANS 8.14	4.4.3	The frequencies of inspection, testing, sampling, and verification prior to use and during the operational lifetime of the neutron absorber shall be established such that they allow determination of the adequacy of the neutron absorbing capability. The frequencies shall allow sufficient time for corrective actions to be taken if absorbing capability shows degradation from established values. Factors that shall be considered include the environment in which the neutron absorbers are placed and the absorber material's chemical, physical, and other properties on which the criticality safety evaluation is based.						(+) CRIT FACILITIES	X	
18.06.372	ANS 8.14	4.4.4	Testing and sample analysis methods to verify neutron absorber concentrations and properties credited in the criticality safety evaluation, prior to use and while in service, shall be calibrated using traceable standards (e.g., from the National Institute of Standards and Technology).						(+) CRIT FACILITIES	X	

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18.06.373	ANS 8.14	4.5.1	Prior to operation, the parameters of the system design important to criticality safety shall be verified to conform to specifications.						(+) CRIT FACILITIES	X	
18.06.374	ANS 8.14	4.5.2	Proper mixing and concentration of the soluble neutron absorber (elemental or isotopic, as appropriate) shall be verified before use.						(+) CRIT FACILITIES	X	
18.06.401	ANS 8.15	4.1	Administrative and Technical Practices. Operations within the scope of this standard shall be conducted in accordance with ANSI/ANS-8.1-2014, except that the subcritical limits given herein may be utilized.						(+) CRIT FACILITIES	X	
18.06.402	ANS 8.15	5	Operations may be performed safely by complying with safety limits and controls based on the appropriate subcritical mass limits given in Tables 1, 2, and 4 or the appropriate subcritical concentration limits given in Table 3. Note: For Tables 1 thru Table 4, see the Source Document.						(+) CRIT FACILITIES	X	
18.06.403	ANS 8.15	5.5	For mixtures of different isotopes of the same material (such as a mixture of 244Cm- and 245Cm), the subcritical limit for the limiting nuclide should be used (which would be 245Cm in this example). Alternatively, the user may calculate their own subcritical limits for mixtures of materials if they need to do so. This calculation should not be a simple relationship, but rather a detailed physics calculation using the latest methods and cross-section evaluations.						(+) CRIT FACILITIES	X	
18.06.451	ANS 8.17	4.9	Reliance may be placed on neutron-absorbing materials, such as gadolinium and boron, that are incorporated in the fuel material itself, incorporated in structures or equipment, or included within solutions integral to the structures or equipment. However, when reliance is placed on neutron-absorbing materials, control shall be exercised to ensure their continued presence with the intended configurations, distributions, and concentrations. Extraordinary care should be taken with solutions of absorbers because of the difficulty of exercising such control and with fuel units containing burnable poison to identify the maximum reactivity condition to be considered. Guidance for the use of fixed neutron absorbers is contained in American National Standard ANSI/ANS-8.21-1995 and for the use of soluble neutron absorbers is contained in American National Standard ANSI/ANS-8.14-2004. Note: ANS 8.21 requirements are provided as S/RID requirements 18.06.601 to 18.06.627 and ANS 8.14 requirements are provided as S/RID requirements 18.06.351 to 18.06.374 in this Functional Area.						(+) CRIT FACILITIES	X	

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18.06.452	ANS 8.17	4.10	In performing the criticality safety evaluation, the fuel characteristics (e.g., material compositions, geometry, temperature) that affect reactivity shall be chosen from the range of credible values such that the maximum neutron multiplication factor of the system is obtained. Credit may be taken for fuel burnup by establishing a maximum fuel unit reactivity and assuring that each fuel unit has a reactivity no greater than the maximum established reactivity. Assurance that the reactivity limit is not exceeded may be provided by (1) a measurement that can be related to the reactivity or (2) an analysis and verification of the exposure history of each fuel unit. Consideration shall be given to the axial distribution of burnup in the fuel unit.						(+) CRIT FACILITIES	X	
18.06.453	ANS 8.17	5.2	Methods that do not directly yield k eff but whose validity has been established in accordance with ANSI/ANS-8.1-1998 may be used to ensure subcriticality. Note: ANS-8.1-1998 has been replaced by ANS-8.1-2014. Validation in ANS-8.1-2014 is found in Section 4.3. The Requirement of 4.3 is included in this Functional Area as Requirement 18.06.066, and points to ANS 8.24 for requirements. Those requirements are found in 18.06.801 through 18.06.826.						(+) CRIT FACILITIES	X	
18.06.454	ANS 8.17	5.3	Appropriate experimental data or data derived from experiments, with an allowance adequate to ensure subcriticality, may be used directly.						(+) CRIT FACILITIES	X	
18.06.455	ANS 8.17	5.4	In situ measurements performed in accordance with American National Standard "Safety in Conducting Subcritical Neutron-Multiplication Measurements In Situ," ANSI/ANS-8.6-1983 may be used to confirm subcriticality. Note: ANS 8.6 requirements are provided as S/RID requirements 18.06.151 to 18.06.173 in this Functional Area.						(+) CRIT FACILITIES	X	
18.06.501	ANS 8.19	4.2	Management Responsibilities Management shall formulate nuclear criticality safety policy and make it known to all employees involved in operations with fissile material.						(+) CRIT FACILITIES	X	
18.06.502	ANS 8.19	4.3	Management Responsibilities Management shall assign responsibility and delegate commensurate authority to implement established policy. Responsibility for nuclear criticality safety should be assigned in a manner consistent with that for other safety disciplines. Each individual, regardless of position, shall be made aware that nuclear criticality safety in his or her work area is his or her responsibility.						(+) CRIT FACILITIES	X	

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				Nuclear HC-1,2,3	Radi-ological	High Hazard Chemical	Low Hazard Chemical	Other Industrial	Facility Specific	Common	Facility Specific
18.06.503	ANS 8.19	4.5	Management Responsibilities Management shall establish a training and qualification program for nuclear criticality safety staff.						(+) CRIT FACILITIES	X	
18.06.504	ANS 8.19	4.6	Management Responsibilities Management shall establish a method to monitor the nuclear criticality safety program.						(+) CRIT FACILITIES	X	
18.06.505	ANS 8.19	4.7	Management Responsibilities Management shall participate in auditing the overall effectiveness of the nuclear criticality safety program at least once every 3 years.						(+) CRIT FACILITIES	X	
18.06.506	ANS 8.19	4.8	Management Responsibilities Management may use consultants and nuclear criticality safety committees to achieve the objectives of the nuclear criticality safety program.						(+) CRIT FACILITIES	X	
18.06.507	ANS 8.19	4.9	Management Responsibilities Management shall establish and maintain a configuration management system that identifies, and controls changes to, facilities, equipment, and processes important to nuclear criticality safety.						(+) CRIT FACILITIES	X	
18.06.508	ANS 8.19	4.10	Management Responsibilities Management shall establish a process for developing, reviewing, supplementing, and revising operating procedures.						(+) CRIT FACILITIES	X	
18.06.509	ANS 8.19	5.1	Supervisory Responsibilities Each supervisor shall accept responsibility for the safety of operations under his or her control.						(+) CRIT FACILITIES	X	
18.06.510	ANS 8.19	5.2	Supervisory Responsibilities Each supervisor shall be knowledgeable in those aspects of nuclear criticality safety relevant to operations under his or her control. Training and assistance should be obtained from the nuclear criticality safety staff.						(+) CRIT FACILITIES	X	
18.06.511	ANS 8.19	5.3	Supervisory Responsibilities Each supervisor shall ensure that nuclear criticality safety training is provided to the personnel under his or her supervision.						(+) CRIT FACILITIES	X	

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18.06.512	ANS 8.19	5.3.1	Supervisory Responsibilities Each supervisor shall require that the personnel under his or her supervision understand procedures, limits, controls, and other nuclear criticality safety considerations such that personnel can be expected to perform their functions without undue risk.						(+) CRIT FACILITIES	X	
18.06.513	ANS 8.19	5.3.2	Supervisory Responsibilities Records of training activities and verification of personnel understanding shall be maintained.						(+) CRIT FACILITIES	X	
18.06.514	ANS 8.19	5.4	Supervisory Responsibilities Supervisor shall develop or participate in the development of written procedures applicable to the operations under their control. Maintenance of these procedures to reflect changes in operations shall be a continuing supervisory responsibility.						(+) CRIT FACILITIES	X	
18.06.515	ANS 8.19	5.5	Supervisory Responsibilities Supervisors shall verify compliance with nuclear criticality safety specifications for new or modified equipment before its use.						(+) CRIT FACILITIES	X	
18.06.516	ANS 8.19	5.6	Supervisory Responsibilities Supervisors shall be responsible for the inspection, testing and maintenance of engineered controls.						(+) CRIT FACILITIES	X	
18.06.517	ANS 8.19	5.7	Supervisory Responsibilities Each supervisor shall require conformance with good safety practices including unambiguous identification of fissile materials and good housekeeping.						(+) CRIT FACILITIES	X	
18.06.518	ANS 8.19	6.1	Nuclear Criticality Safety Staff Responsibilities The nuclear criticality safety staff shall provide technical guidance for the design of equipment and processes and for the development of operating procedures.						(+) CRIT FACILITIES	X	
18.06.519	ANS 8.19	6.2	Nuclear Criticality Safety Staff Responsibilities The staff shall maintain familiarity with current developments in nuclear criticality safety standards, and guides. Knowledge of current nuclear criticality information should be maintained.						(+) CRIT FACILITIES	X	

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18.06.520	ANS 8.19	6.3	Nuclear Criticality Safety Staff Responsibilities The staff should consult with knowledgeable individuals to obtain technical assistance as needed.						(+) CRIT FACILITIES	X	
18.06.521	ANS 8.19	6.4	Nuclear Criticality Safety Staff Responsibilities The staff shall maintain familiarity with all operations within the organization requiring nuclear criticality safety controls. This shall be accomplished by individual staff members maintaining familiarity with operations for which they provide guidance.						(+) CRIT FACILITIES	X	
18.06.522	ANS 8.19	6.5	Nuclear Criticality Safety Staff Responsibilities The staff shall assist supervision, on request, in training personnel.						(+) CRIT FACILITIES	X	
18.06.523	ANS 8.19	6.6	Nuclear Criticality Safety Staff Responsibilities The staff shall conduct or participate in audits of nuclear criticality safety practices, including compliance with procedures, as directed by management.						(+) CRIT FACILITIES	X	
18.06.524	ANS 8.19	6.7	Nuclear Criticality Safety Staff Responsibilities The staff shall examine reports of procedural violations and other deficiencies for improvement of safety practices and procedural requirements. Findings shall be reported to management.						(+) CRIT FACILITIES	X	
18.06.525	ANS 8.19	6.8	Nuclear Criticality Safety Staff Responsibilities The staff should periodically review nuclear criticality safety evaluations to determine their continued applicability and validity. This should include a review of elements of the evaluation such as scope, assumptions, normal conditions, credible abnormal conditions, controls, and limits.						(+) CRIT FACILITIES	X	
18.06.526	ANS 8.19	7.1.1	Evaluations for nuclear criticality safety Normal and credible abnormal conditions shall be determined with input from operations or other knowledgeable individuals.						(+) CRIT FACILITIES	X	
18.06.527	ANS 8.19	7.1.2	Evaluations for nuclear criticality safety During development of the nuclear criticality safety evaluation, the staff performing the evaluation should personally observe relevant existing equipment, activities, and processes.						(+) CRIT FACILITIES	X	

TABLE 1 - S/RID FUNCTIONAL AREA 18 (NUCLEAR AND PROCESS SAFETY) REQUIREMENTS

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				Nuclear HC-1,2,3	Radi-ological	High Hazard Chemical	Low Hazard Chemical	Other Industrial	Facility Specific	Common	Facility Specific
18.06.528	ANS 8.19	7.2	Evaluations for nuclear criticality safety The nuclear criticality safety evaluation shall determine and explicitly identify the controlled parameters and their associated limits upon which nuclear criticality safety depends. The effect of changes in these parameters, or in the conditions to which they apply, shall be understood						(+) CRIT FACILITIES	X	
18.06.529	ANS 8.19	7.3	Evaluations for nuclear criticality safety The nuclear criticality safety evaluation shall be documented with sufficient detail, clarity, and lack of ambiguity to allow independent judgment of results by personnel familiar with the physics of nuclear criticality, the facility operations, and the associated nuclear criticality safety practices.						(+) CRIT FACILITIES	X	
18.06.530	ANS 8.19	7.4	Evaluations for nuclear criticality safety Before the start of operation, there shall be an independent review that confirms the adequacy of the nuclear criticality safety evaluation. The reviewer shall be familiar with the physics of nuclear criticality, the facility operations, and the associated nuclear criticality safety practices.						(+) CRIT FACILITIES	X	
18.06.531	ANS 8.19	7.5	Evaluations for nuclear criticality safety Before the start of operation, the supervisor responsible for the operation should confirm that the nuclear criticality safety evaluation adequately identifies normal and credible abnormal conditions and establishes requirements that are verifiable and compatible with the planned operation.						(+) CRIT FACILITIES	X	
18.06.532	ANS 8.19	8.1	Implementation and maintenance of nuclear criticality safety controls Nuclear criticality safety controls shall be implemented and maintained to provide subcriticality for fissile material operations under both normal and credible abnormal conditions.						(+) CRIT FACILITIES	X	
18.06.533	ANS 8.19	8.2	Implementation and maintenance of nuclear criticality safety controls Before the start of operation, proper implementation of nuclear criticality safety controls shall be verified.						(+) CRIT FACILITIES	X	

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18.06.534	ANS 8.19	8.3	Implementation and maintenance of nuclear criticality safety controls Before a process that has been in extended shutdown is restarted, operations personnel and the nuclear criticality safety staff shall perform a review to determine if there have been any changes that could adversely affect nuclear criticality safety. These changes could include different material forms, degradation of process equipment, new or altered ancillary systems, procedure revisions, or changes to the surroundings.						(+) CRIT FACILITIES	X	
18.06.535	ANS 8.19	8.3.1	Implementation and maintenance of nuclear criticality safety controls Changes that adversely affect nuclear criticality safety shall be addressed by evaluation.						(+) CRIT FACILITIES	X	
18.06.536	ANS 8.19	8.3.2	Implementation and maintenance of nuclear criticality safety controls Implementation of appropriate controls, including supplemental worker training, shall be verified prior to restart.						(+) CRIT FACILITIES	X	
18.06.537	ANS 8.19	8.3.3	Implementation and maintenance of nuclear criticality safety controls Extended shutdown considerations do not apply to processes that are performed periodically, were evaluated accordingly, and have maintained the established nuclear criticality safety controls.						(+) CRIT FACILITIES	X	
18.06.538	ANS 8.19	8.4	Implementation and maintenance of nuclear criticality safety controls The facility configuration management system shall include those engineered controls significant to the nuclear criticality safety of the operation.						(+) CRIT FACILITIES	X	
18.06.539	ANS 8.19	8.5.1	Implementation and maintenance of nuclear criticality safety controls Procedures should be organized for convenient use by operators and be conveniently available. They should be free of extraneous material.						(+) CRIT FACILITIES	X	
18.06.540	ANS 8.19	8.5.3	Implementation and maintenance of nuclear criticality safety controls New or revised procedures that have an impact upon nuclear criticality safety shall be reviewed by the nuclear criticality safety staff.						(+) CRIT FACILITIES	X	
18.06.541	ANS 8.19	8.5.4	Implementation and maintenance of nuclear criticality safety controls Procedures should be supplemented by posted nuclear criticality safety limits or limits incorporated in operating checklists, flow sheets, or inventory control systems. Where these supplements are used, they shall be kept in good repair, legible, and consistent with current controls and limits.						(+) CRIT FACILITIES	X	

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18.06.542	ANS 8.19	8.5.5	Implementation and maintenance of nuclear criticality safety controls Active procedures shall be reviewed periodically by supervision.						(+) CRIT FACILITIES	X	
18.06.543	ANS 8.19	8.6	Operations shall be reviewed at least annually to verify that procedures are being followed and that process conditions have not been altered so as to affect the nuclear criticality safety evaluation.						(-) CRIT FACILITIES	X	
18.06.544	ANS 8.19	8.6.1	Operations shall be reviewed at least annually to verify that procedures are being followed and that process conditions have not been altered so as to affect the nuclear criticality safety evaluation.						(-) CRIT FACILITIES	X	
18.06.545	ANS 8.19	8.6.2	These reviews (annual operation reviews (8.6)) shall be documented.						(+) CRIT FACILITIES	X	
18.06.546	ANS 8.19	8.7	Implementation and maintenance of nuclear criticality safety controls Deviations from procedures and unintended alterations in process conditions that affect nuclear criticality safety shall be reported to management, investigated promptly, corrected as appropriate, and documented. Action to correct such deviations or alterations shall be taken in accordance with procedure requirements or with guidance obtained from the nuclear criticality safety staff. Action shall be taken to prevent recurrence.						(+) CRIT FACILITIES	X	
18.06.547	ANS 8.19	8.8	Implementation and maintenance of nuclear criticality safety controls Personnel should be encouraged to provide feedback on the nuclear criticality safety program, including identification of concerns or circumstances that could adversely impact nuclear criticality safety, practices that favorably impact nuclear criticality safety, and identification of potential improvements.						(+) CRIT FACILITIES	X	
18.06.548	ANS 8.19	8.9	Implementation and maintenance of nuclear criticality safety controls Access to areas where fissile material is handled, processed, or stored shall be controlled.						(+) CRIT FACILITIES	X	
18.06.549	ANS 8.19	8.11	Implementation and maintenance of nuclear criticality safety controls Fissile material shall be identified and tracked by effective methods appropriate to the activity or process. Methods such as labeling, inventory control systems, and area posting should be considered.						(+) CRIT FACILITIES	X	

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18.06.551	ANS 8.20	5.0	Program Responsibilities 5.1 Management shall establish a nuclear criticality safety training program that provides confidence in the continuing proficiency of personnel. 5.2 Supervisors shall ensure that their staffs are suitably trained. 5.3 Nuclear criticality safety staff shall participate in the development of the training program and should participate in its implementation and the evaluation of its effectiveness.						(+) CRIT FACILITIES	X	
18.06.552	ANS 8.20	6.0	Program Structure 6.1 Training requirements shall be determined and documented. The content of the training program shall be tailored to job responsibilities and shall support the conduct of the job. 6.2 Refresher training requirements shall be determined and documented. Such training shall be provided at least every two years. 6.3 The learning objectives of each lesson should be made available to the trainees.						(+) CRIT FACILITIES	X	
18.06.553	ANS 8.20	7.1.1	Program Content (See Note) Fission Chain Reactions and Accident Consequences The concept of a fission chain reaction should be discussed. The distinction should be made among families of chains in which fission rate decreases with time, those that are sustained with a constant fission rate, and those that have an exponential increase in the fission rate. Note: The order of presentation need not follow the numbered sequence in this section.						(+) CRIT FACILITIES	X	
18.06.554	ANS 8.20	7.1.2	Program Content. Fission Chain Reactions and Accident Consequences The time history of supercritical excursions should be described for metal (fast neutron) systems and for moderated (slow neutron) 'systems. 7.1.2.1 The kinetic energy released during the fission burst should be compared to the equivalent energy measured in familiar events, for example, chemical explosions. 7.1.2.2 A distinction should be made between the intensity of radiation that may appear essentially instantaneously, as from a spike yield, and that which may be expected to be associated with a continuing fission reaction. This information should be used to estimate the range of exposures that may be associated with process accidents.						(+) CRIT FACILITIES	X	

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18.06.555	ANS 8.20	7.1.3	Program Content Fission Chain Reactions and Accident Consequences Health effects of criticality accidents shall be discussed.						(+) CRIT FACILITIES	X	
18.06.556	ANS 8.20	7.2	Program Content Neutron Behavior in Fissioning Systems 7.2.1 A description of neutron-induced fission, neutron capture, and neutron scattering and leakage should be included. 7.2.2 The influence of neutron energy on the fission probability should be discussed. 7.2.3 Neutron moderation should be explained as the mechanism that reduces the neutron energy. Several good neutron moderators should be identified. 7.2.4 Removal of neutrons from fissioning systems by neutron absorbers should be discussed.						(+) CRIT FACILITIES	X	
18.06.557	ANS 8.20	7.3	Program Content Criticality Accident History 7.3.1 Selected criticality accidents should be described. 7.3.2 The causes of the selected criticality accidents and the means of their termination should be discussed.						(+) CRIT FACILITIES	X	
18.06.558	ANS 8.20	7.4	Program Content Response to Criticality Alarm Signals 7.4.1 Training shall be provided in the recognition of and in the response to criticality alarms in accordance with ANS-8.3-1997. 7.4.2 An example of the reduction in the received dose as a function of distance, time, and shielding shall be given to emphasize the need for prompt evacuation. Note: ANS 8.3-1997 is found in this Functional Area as Requirements 18.06.101 through 18.06.135.						(+) CRIT FACILITIES	X	

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18.06.559	ANS 8.20	7.5.1	Program Content Control Parameters The effects and applications of the following factors that are relevant to criticality safety of operations in the facility shall be explained and illustrated: (1) mass (2) shape (3) interaction and separation (4) moderation (5) reflection (6) concentration (7) volume (8) density (9) neutron absorbers (10) heterogeneity (11) enrichment.						(+) CRIT FACILITIES	X	
18.06.560	ANS 8.20	7.5.2	Program Content Control Parameters Single parameter limits appropriate to the facility shall be discussed.						(+) CRIT FACILITIES	X	
18.06.561	ANS 8.20	7.5.3	Program Content Control Parameters The concept of nuclear criticality shall be illustrated by examples appropriate to the facility. The following are typical illustrations: (1) the change in critical mass of small pieces of fissionable material, such as lathe turnings or low enriched pellets, upon immersion in water or oil (2) the influence of nonfissionable materials and of geometry on nuclear criticality (3) factors affecting interaction among units.						(+) CRIT FACILITIES	X	
18.06.562	ANS 8.20	7.5.4	Program Content Control Parameters The concept of contingencies for checking the validity of criticality safety limits shall be discussed.						(+) CRIT FACILITIES	X	

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18.06.563	ANS 8.20	7.6	Program Content Policy and Procedures 7.6.1 The facility management's nuclear criticality safety policy shall be described. 7.6.2 The facility policy for the use of check lists, sign-off sheets, and documentation in the execution of procedures that are pertinent to criticality safety shall be explained. 7.6.3 Relevant procedures that pertain to criticality safety shall be discussed. Emphasis shall be given to criticality safety limits, controls, and emergency procedures. 7.6.4 The policy that relates to situations not covered by procedures and to situations in which the safety of the operation is in question shall be described. 7.6.5 Employees shall be informed of their right to question any operations that they believe may not be safe.						(+) CRIT FACILITIES	X	
18.06.564	ANS 8.20	8.0	Evaluation 8.1 Training Program. The criticality safety training program of an organization shall be evaluated periodically. The evaluation process should provide confidence in the adequacy of the total training program. The evaluation process and the evaluations shall be documented. 8.2 Personnel. Satisfactory completion of training shall be based upon predetermined performance criteria. Evaluation methods should include written, oral, and operational examinations. Identified weaknesses shall be addressed by additional training. Acceptance of the adequacy of the individual's total training record shall be the responsibility of the immediate supervisor and any other organizational units designated by management. 8.3 Documentation. The employee's training record shall be documented and retained for a minimum of four years or longer as required by management.						(+) CRIT FACILITIES	X	
18.06.601	ANS 8.21	5.1.1	Fixed neutron absorbers shall be designed to maintain their required geometrical relationship with fissionable materials during the intended operating life.						(+) CRIT FACILITIES	X	
18.06.602	ANS 8.21	5.1.1.1	A means of verification shall be provided to determine that the design, safety, and operating requirements are met for all neutron absorber system components. Requirements for in-service verification shall be considered during the design of the neutron absorber system.						(+) CRIT FACILITIES	X	

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18.06.603	ANS 8.21	5.1.1.2	The design shall include assessment of the operating environment. Degradation of the neutron absorber or materials used to protect the neutron absorber due to chemical, physical, radiological, and mechanical impacts shall be protected against or allowed for in the design process.						(+) CRIT FACILITIES	X	
18.06.604	ANS 8.21	5.1.1.2.1	The fixed neutron absorber shall be designed to maintain its designed neutron absorption capability during its intended operating life, including all credible conditions of neutron moderation and reflection.						(+) CRIT FACILITIES	X	
18.06.605	ANS 8.21	5.1.1.2.2	Radiation effects on the neutron absorber system over its expected life (e.g., depletion by neutron absorption, embrittlement and radiolysis) shall be evaluated.						(+) CRIT FACILITIES	X	
18.06.606	ANS 8.21	5.1.1.3	The design shall make allowances for process material variations, for manufacturing tolerances, for uncertainties in the absorber density and distribution, and for uncertainties in the nuclear properties (such as the accuracy of neutron cross sections) of the neutron absorber.						(+) CRIT FACILITIES	X	
18.06.607	ANS 8.21	5.1.2	The neutron absorber system shall be designed such that the criticality safety function is not compromised for all credible operation and natural phenomena events for the facility or equipment.						(+) CRIT FACILITIES	X	
18.06.608	ANS 8.21	5.1.3	The neutron absorber system shall be designed to prevent inadvertent removal, displacement, or alteration of its components.						(+) CRIT FACILITIES	X	
18.06.609	ANS 8.21	5.1.4	The design of equipment and facilities incorporating fixed neutron absorbers shall incorporate human factors engineering practices for installation, operation, and maintenance of fixed neutron absorbers.						(+) CRIT FACILITIES	X	
18.06.610	ANS 8.21	5.1.5	The requirements of operations, fissionable material accountability, and other safety disciplines shall be considered in the design of the neutron absorber system.						(+) CRIT FACILITIES	X	
18.06.611	ANS 8.21	5.2.1.1	The potential for neutron absorber degradation in the normal operating environment due to physical or chemical actions and any material composition changes, and changes in the material of the neutron absorber system (for example, cladding), shall be assessed.						(+) CRIT FACILITIES	X	
18.06.612	ANS 8.21	5.2.1.2	The impact of credible adverse environmental and operating conditions on the neutron absorber system, such as radiation damage, chemical reactions, fire, temperature variation, pressure conditions, vibrations, mechanical impacts, abrasion, corrosion, inadvertent removal, depletion, and flooding, shall be evaluated.						(+) CRIT FACILITIES	X	
18.06.613	ANS 8.21	5.2.1.3	Any event that subjects the neutron absorber system to physical or chemical conditions outside the design envelope shall require the reassessment of the system prior to restart of operations.						(+) CRIT FACILITIES	X	
18.06.614	ANS 8.21	5.2.2.1	The calculational methods used shall replicate the effect of neutron flux depressions associated with localized neutron absorbers.						(+) CRIT FACILITIES	X	

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18.06.615	ANS 8.21	5.2.2.2	The effect on criticality of inhomogeneity (for example, neutron streaming through the neutron absorber material) of the fixed neutron absorbers shall be assessed.						(+) CRIT FACILITIES	X	
18.06.616	ANS 8.21	5.2.3	Evaluations shall consider manufacturing tolerances, material substitutions, geometry changes, corrosion allowance, modeling assumptions, process variables, and other relevant uncertainties.						(+) CRIT FACILITIES	X	
18.06.617	ANS 8.21	5.3.1	The inspection and verification plan for fixed neutron absorber systems shall conform to the operating facility quality assurance requirements. Any actions as a result of the plan shall not compromise the nuclear criticality safety of the operating system. The inspection and verification shall be documented, and records shall be maintained for the operating life of the facility and of the neutron absorber system.						(+) CRIT FACILITIES	X	
18.06.618	ANS 8.21	5.3.1.1	The required frequency of inspection and the extent of in-service verification shall be determined. Factors that shall be considered include the safety analyses, the environment in which the absorber are placed, and the absorber material properties.						(+) CRIT FACILITIES	X	
18.06.619	ANS 8.21	5.3.1.2	If required, the in-service verification methods used to measure the properties of the absorber may include neutronic techniques, other nondestructive techniques, or chemical testing methods.						(+) CRIT FACILITIES	X	
18.06.620	ANS 8.21	5.3.1.3	Testing methods used to verify neutron absorber properties shall be calibrated to material standards traceable to the National Institute of Standards and Technology.						(+) CRIT FACILITIES	X	
18.06.621	ANS 8.21	5.3.2	The inspection and verification plan shall be implemented for the material acquisition, neutron absorber system component manufacturing, installation, operation, and maintenance of the neutron absorber system.						(+) CRIT FACILITIES	X	
18.06.622	ANS 8.21	5.3.2.1	Fixed neutron absorber material verification (elemental or isotopic as appropriate) shall be obtained before use.						(+) CRIT FACILITIES	X	
18.06.623	ANS 8.21	5.3.2.2	The neutron absorber system components shall be verified to conform with design drawings and specifications before installation.						(+) CRIT FACILITIES	X	
18.06.624	ANS 8.21	5.3.2.3	Proper installation of the neutron absorber system shall be verified prior to use.						(+) CRIT FACILITIES	X	
18.06.625	ANS 8.21	5.3.2.4	The operation of the neutron absorber system and its maintenance shall be verified to conform to the safety evaluation requirements.						(+) CRIT FACILITIES	X	
18.06.626	ANS 8.21	5.3.3	Results of in-service verifications shall be evaluated and, if necessary, appropriate corrective actions shall be taken.						(+) CRIT FACILITIES	X	
18.06.651	ANS 8.22	4.1.1	Written procedures shall include the nuclear criticality safety limits and controls for operation. These procedures should address any steps to be taken if a moderator control fails.						(+) CRIT FACILITIES	X	
18.06.652	ANS 8.22	4.1.2	Written procedures shall be provided for monitoring, testing, and maintenance to ensure that the limits and controls specified in process evaluations are maintained.						(+) CRIT FACILITIES	X	

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18.06.653	ANS 8.22	4.1.3	Written procedures shall be provided for moderator sampling and analysis as Required by the process evaluation.						(+) CRIT FACILITIES	X	
18.06.654	ANS 8.22	4.1.4	Moderator control areas shall be identified to personnel having access to such areas. Note: This requirement has been modified to reflect SRS specific operational situations						(+) CRIT FACILITIES	X	
18.06.655	ANS 8.22	4.1.5	Moderator control limits shall be posted as appropriate. Note: This requirement has been modified to reflect SRS specific operational situations						(+) CRIT FACILITIES	X	
18.06.656	ANS 8.22	4.1.6	Moderator control requirements shall be included in the fire-fighting plans as necessary. Note: This requirement has been modified to reflect SRS specific operational situations						(+) CRIT FACILITIES	X	
18.06.657	ANS 8.22	4.1.7	Combustible materials in moderator control areas should be minimized.						(+) CRIT FACILITIES	X	
18.06.658	ANS 8.22	4.1.8	Training in understanding and complying with moderator limits and controls shall be provided to appropriate personnel as part of nuclear criticality safety training. Additional guidance can be found in American National Standard for Nuclear Criticality Safety Training, ANSI/ANS-8.20-1991.						(+) CRIT FACILITIES	X	
18.06.659	ANS 8.22	4.2.1	The process evaluation shall define the moderator control area.						(+) CRIT FACILITIES	X	
18.06.660	ANS 8.22	4.2.3	The process evaluation shall explicitly identify the limits, controls and engineered barriers for moderator control areas. The limits shall be based on experimental data or derived through the use of calculational methods which are validated as required by ANSI/ANS-8.1 [1]. Note:ANS-8.1-1983 has been replaced by ANS-8.1-2014. Validation in ANS-8.1-2014 is found in Section 4.3. The Requirement of 4.3 is included in this Functional Area as Requirement 18.06.066, and points to ANS-8.24 for requirements. Those requirements are found in 18.06.801 through 18.06.826.						(+) CRIT FACILITIES	X	
18.06.661	ANS 8.22	4.2.4	The process evaluation shall address properties of all materials present that could change the moderator content. Examples of properties of interest include hygroscopic, hydric, absorptive, adsorptive, and radiolytic natures of the materials.						(+) CRIT FACILITIES	X	
18.06.662	ANS 8.22	4.2.5	The process evaluation shall address moderators present in, introduced to, or accumulated in a moderator control area, either by design or by accident.						(+) CRIT FACILITIES	X	

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18.06.663	ANS 8.22	4.2.6	The process evaluation shall address the distribution of the moderators within the fissile material and between discrete fissile material units. Nonuniform distribution of moderators that might occur during mechanical (e.g., mixing), thermal, or chemical processes shall also be addressed.						(+) CRIT FACILITIES	X	
18.06.664	ANS 8.22	4.2.7	The process evaluation should address tolerances and changes in the appropriate chemical and physical properties of the moderator.						(+) CRIT FACILITIES	X	
18.06.665	ANS 8.22	4.2.8	The process evaluation should address the adequacy and integrity of containers used to transfer and store moderators or moderator controlled materials in a moderator controlled area.						(+) CRIT FACILITIES	X	
18.06.666	ANS 8.22	4.2.9	The process evaluation shall address moderators that might be encountered during maintenance, decontamination, construction, and non-operational activities.						(+) CRIT FACILITIES	X	
18.06.667	ANS 8.22	4.2.10	The process evaluation shall address the need for special controls involving fire prevention and suppression. The impact of fire fighting in adjacent areas should also be considered.						(+) CRIT FACILITIES	X	
18.06.668	ANS 8.22	4.2.11	The process evaluation shall establish the requirements for moderator measurement necessary to ensure specified limits and controls are maintained.						(+) CRIT FACILITIES	X	
18.06.669	ANS 8.22	5.1	Moderator Control Area Barriers. Moderator control areas shall be provided with engineered barriers as required by the process evaluation. Consideration should be given to potential hazards external to the moderator control areas that could compromise the integrity of the engineered barriers.						(+) CRIT FACILITIES	X	
18.06.670	ANS 8.22	5.2	Equipment and Containers. Fissile material processing equipment and containers used in moderator controlled areas shall be designed, constructed, and maintained to limit and control moderators in accordance with the process evaluation.						(+) CRIT FACILITIES	X	
18.06.671	ANS 8.22	5.3.1	Penetrations into a moderator control area should be minimized.						(+) CRIT FACILITIES	X	
18.06.672	ANS 8.22	5.3.2	Systems that penetrate a moderator control area and normally contain moderators shall have limits and controls as required by the process evaluation.						(+) CRIT FACILITIES	X	
18.06.673	ANS 8.22	5.3.3	Systems (such as ventilation ducts, compressed gas lines, electrical conduits, and drains) that penetrate a moderator control area, but which do not normally contain moderators, shall have controls as required by the process evaluation.						(+) CRIT FACILITIES	X	
18.06.674	ANS 8.22	5.4.1	Fire control in moderator control areas shall incorporate the design features identified by the process evaluation. The use of non-moderating fire suppressant media should be considered.						(+) CRIT FACILITIES	X	

TABLE 1 - S/RID FUNCTIONAL AREA 18 (NUCLEAR AND PROCESS SAFETY) REQUIREMENTS

S/RID Requirement Number	Source Document	Source Document Reqt Number	Requirement Text	SRR Applicability						Phase I Compliance	
				Nuclear HC-1,2,3	Radi-ological	High Hazard Chemical	Low Hazard Chemical	Other Industrial	Facility Specific	Common	Facility Specific
18.06.675	ANS 8.22	5.4.2	Preference should be given to the use of non-combustible or fire-resistant building components, equipment, and materials to reduce the probability of introducing moderator material in fire fighting activities.						(+) CRIT FACILITIES	X	
18.06.676	ANS 8.22	5.4.3	Combustible materials should be minimized in moderator control areas to reduce the probability of introducing moderator material during fire fighting activities. Necessary materials that are combustible or not fire resistant should be maintained in a manner to minimize the risk of fire.						(+) CRIT FACILITIES	X	
18.06.677	ANS 8.22	5.5	Instrumentation and Controls. Instrumentation and controls may be used to detect or prevent the presence of moderators. Instrumentation and controls identified in the process evaluation shall be designed, installed, operated, and maintained in accordance with site requirements.						(+) CRIT FACILITIES	X	
18.06.701	ANS 8.23	4.1(1)	Management Responsibilities Management shall ensure the following: (1) Staff with relevant expertise is provided;						(+) CRIT FACILITIES	X	
18.06.702	ANS 8.23	4.1(2)	Management Responsibilities Management shall ensure the following: (2) An emergency response plan is established, exercised, and maintained;						(+) CRIT FACILITIES	X	
18.06.703	ANS 8.23	4.1(3)	Management Responsibilities Management shall ensure the following: (3) Immediate evacuation zones and evacuation routes are established						(+) CRIT FACILITIES	X	
18.06.704	ANS 8.23	4.1(4)	Management Responsibilities Management shall ensure the following: (4) A personnel assembly station (or stations) is established, and a method is provided for timely accounting of all personnel who were within the immediate evacuation zone at the time of the evacuation;						(+) CRIT FACILITIES	X	
18.06.705	ANS 8.23	4.1(5)	Management Responsibilities Management shall ensure the following: (5) Instrumentation and equipment needed to respond to a criticality accident are provided.						(+) CRIT FACILITIES	X	

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18.06.706	ANS 8.23	4.1(6)	Management Responsibilities Management shall ensure the following: (6) The level of readiness (including training) needed for response to a criticality accident is adequate.						(+) CRIT FACILITIES	X	
18.06.707	ANS 8.23	4.1(7)	Management Responsibilities Management shall ensure the following: (7) The capability to perform radiological dose assessments for response to criticality accidents is provided.						(+) CRIT FACILITIES	X	
18.06.708	ANS 8.23	4.1(8)	Management Responsibilities Management shall ensure the following: (8) A communication system for central coordination of all site emergency activities is provided;						(+) CRIT FACILITIES	X	
18.06.709	ANS 8.23	4.1(9)	Management Responsibilities Management shall ensure the following: (9) A nuclear accident dosimetry system as specified in American National Standard “Dosimetry for Criticality Accidents,” ANSI N13.3-1969 (R1981) withdrawn is provided;						(+) CRIT FACILITIES	X	
18.06.710	ANS 8.23	4.1(10)	Management Responsibilities Management shall ensure the following: (10) Equipment such as a criticality accident alarm system defined in ANS-8.3-1997 (R2003) and procedures are in place to activate the emergency response when needed. Note: ANS-8.3-1997 is found in this Functional Area as Requirements 18.06.101 through 18.06.135.						(+) CRIT FACILITIES	X	
18.06.711	ANS 8.23	4.2.1(1)	Technical Staff Responsibilities 4.2.1 Planning The technical staff shall (1) Identify potential criticality accident locations.						(+) CRIT FACILITIES	X	

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18.06.712	ANS 8.23	4.2.1(2)	Technical Staff Responsibilities 4.2.1 Planning The technical staff shall (2) Evaluate and characterize potential criticality accidents, with this work to include radiological dose prediction.						(+) CRIT FACILITIES	X	
18.06.713	ANS 8.23	4.2.1(3)	Technical Staff Responsibilities 4.2.1 Planning The technical staff shall (3) Determine the instrumentation and equipment requirements for emergency response activities.						(+) CRIT FACILITIES	X	
18.06.714	ANS 8.23	4.2.1(4)	Technical Staff Responsibilities 4.2.1 Planning The technical staff shall (4) Define the immediate evacuation zone for each potential criticality accident location.						(+) CRIT FACILITIES	X	
18.06.715	ANS 8.23	4.2.1(5)	Technical Staff Responsibilities 4.2.1 Planning The technical staff shall (5) Participate in the planning, conduct, and evaluation of exercises and drills.						(+) CRIT FACILITIES	X	
18.06.716	ANS 8.23	4.2.2(1)	Technical Staff Responsibilities 4.2.2 Emergency Response During an emergency response the technical staff shall: (1) Be available to advise and assist the emergency coordinator in responding to the criticality accident.						(+) CRIT FACILITIES	X	

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18.06.717	ANS 8.23	4.2.2(2)	Technical Staff Responsibilities 4.2.2 Emergency Response During an emergency response the technical staff shall: (2) conduct a radiological dose assessment appropriate for a criticality accident						(+) CRIT FACILITIES	X	
18.06.718	ANS 8.23	5.1.1	Emergency Response Planning 5.1 Evaluation 5.1.1 Potential criticality accident locations and predicted accident characteristics shall be evaluated and documented in sufficient detail to assist emergency planning. This evaluation may be based on professional judgment or a more detailed analysis. The description should include the estimated fission yield. The likelihood of recurrence of criticality should be considered.						(+) CRIT FACILITIES	X	
18.06.719	ANS 8.23	5.1.2	Emergency Response Planning 5.1 Evaluation 5.1.2 An immediate evacuation zone shall be established based on the documented evaluation. Emergency Response Planning shall establish a maximum acceptable value for the absorbed dose at the immediate evacuation zone boundary. The basis for the maximum acceptable value shall be documented. Shielding may be considered in establishing the immediate evacuation zone. The localized effects of a criticality accident, and the fact that rapid evacuation is not without risk, may result in an immediate evacuation zone that is significantly smaller than an entire site.						(+) CRIT FACILITIES	X	
18.06.720	ANS 8.23	5.2.1	Emergency Response Planning 5.2 Emergency Response Plan 5.2.1 The emergency response plan consistent with the documented accident evaluation required in Sec. 5.1.1, shall be established and maintained. The emergency response plan may form an integral part of, or be separate from, other plans.						(+) CRIT FACILITIES	X	

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18.06.721	ANS 8.23	5.2.2	Emergency Response Planning 5.2 Emergency Response Plan 5.2.2 The emergency response plan shall include guidance to management, technical staff, and response personnel for response to a criticality accident. The plan shall address recommended protective actions, functions of response personnel, and equipment needed for criticality accident response.						(+) CRIT FACILITIES	X	
18.06.722	ANS 8.23	5.2.3	Emergency Response Planning 5.2 Emergency Response Plan 5.2.3 The emergency response plan shall identify potential criticality accident locations and include appropriate facility descriptions.						(+) CRIT FACILITIES	X	
18.06.723	ANS 8.23	5.2.4(1)	Emergency Response Planning 5.2 Emergency Response Plan 5.2.4 The emergency response plan shall include provisions for (1) an emergency coordinator						(+) CRIT FACILITIES	X	
18.06.724	ANS 8.23	5.2.4(2)	Emergency Response Planning 5.2 Emergency Response Plan 5.2.4 The emergency response plan shall include provisions for (2) activating emergency response						(+) CRIT FACILITIES	X	
18.06.725	ANS 8.23	5.2.4(3)	Emergency Response Planning 5.2 Emergency Response Plan 5.2.4 The emergency response plan shall include provisions for (3) responding to concurrent emergencies, for example, fire, personnel injury, or security incidents;						(+) CRIT FACILITIES	X	
18.06.726	ANS 8.23	5.2.4(4)	Emergency Response Planning 5.2 Emergency Response Plan 5.2.4 The emergency response plan shall include provisions for (4) identifying exposed personnel and determining their radiation dose						(+) CRIT FACILITIES	X	

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18.06.727	ANS 8.23	5.2.4(5)	Emergency Response Planning 5.2 Emergency Response Plan 5.2.4 The emergency response plan shall include provisions for (5) appropriate medical care for exposed personnel;						(+) CRIT FACILITIES	X	
18.06.728	ANS 8.23	5.2.4(6)	Emergency Response Planning 5.2 Emergency Response Plan 5.2.4 The emergency response plan shall include provisions for (6) evaluating the consequences of the criticality accident, including those from radioactive and nonradioactive hazardous materials that might be released as a result of the accident;						(+) CRIT FACILITIES	X	
18.06.729	ANS 8.23	5.2.4(7)	Emergency Response Planning 5.2 Emergency Response Plan 5.2.4 The emergency response plan shall include provisions for (7) determining when the emergency condition no longer exists;						(+) CRIT FACILITIES	X	
18.06.730	ANS 8.23	5.2.4(8)	Emergency Response Planning 5.2 Emergency Response Plan 5.2.4 The emergency response plan shall include provisions for (8) coordinating with emergency organizations expected to provide emergency response assistance. These organizations maybe onsite or offsite;						(+) CRIT FACILITIES	X	
18.06.731	ANS 8.23	5.2.4(9)	Emergency Response Planning 5.2 Emergency Response Plan 5.2.4 The emergency response plan shall include provisions for (9) assembly and accountability of personnel.						(+) CRIT FACILITIES	X	
18.06.732	ANS 8.23	5.2.5	Emergency Response Planning 5.2 Emergency Response Plan 5.2.5 The emergency response plan may be activated on any indication that a criticality accident is developing, is occurring, or has occurred.						(+) CRIT FACILITIES	X	

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18.06.733	ANS 8.23	5.3.1	Emergency Response Planning 5.3 Equipment 5.3.1 Appropriate protective clothing and equipment shall be provided for response personnel. This clothing and equipment can include respiratory protection equipment, anti-contamination suits, both high-range and low-range gamma radiation detection equipment, neutron detection equipment, communications equipment, and personal monitoring devices such as selfreading pocket dosimeters.						(+) CRIT FACILITIES	X	
18.06.734	ANS 8.23	5.3.2	Emergency Response Planning 5.3 Equipment 5.3.2 Appropriate monitoring equipment to determine if further evacuation is needed and to identify exposed individuals shall be provided for use at personnel assembly stations.						(+) CRIT FACILITIES	X	
18.06.735	ANS 8.23	6.1	Evacuation 6.1 When an evacuation is initiated, all personnel within the immediate evacuation zone shall evacuate without hesitation by planned evacuation routes to an established assembly station (or stations).						(+) CRIT FACILITIES	X	
18.06.736	ANS 8.23	6.2	Evacuation 6.2 Radiation levels shall be monitored in occupied areas adjacent to the immediate evacuation zone after initiation of the emergency response.						(+) CRIT FACILITIES	X	
18.06.737	ANS 8.23	6.3	Evacuation 6.3 Radiation levels shall be monitored periodically at the assembly station(s) after initiation of the emergency response.						(+) CRIT FACILITIES	X	
18.06.738	ANS 8.23	6.4	Evacuation 6.4 If the monitoring required by Secs. 6.2 and 6.3 indicates that the dose rate exceeds 1 mSv/hr (100 mrem/hr) in areas that continue to be occupied, nonemergency response personnel shall be evacuated from those areas.						(+) CRIT FACILITIES	X	
18.06.739	ANS 8.23	6.5	Evacuation 6.5 Sufficient exits from the immediate evacuation zone shall be provided to enable rapid and unobstructed evacuation of personnel. Immediate evacuation for personnel protection shall take precedence over contamination control or security considerations.						(+) CRIT FACILITIES	X	

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18.06.740	ANS 8.23	6.6	Evacuation 6.6 Identification of Assembly Stations. Assembly stations shall be clearly identified or posted.						(+) CRIT FACILITIES	X	
18.06.741	ANS 8.23	6.7	Evacuation 6.7 Evacuation routes should be planned to minimize the total risk considering all potential hazards, for example, chemical, industrial, and radiation.						(+) CRIT FACILITIES	X	
18.06.742	ANS 8.23	7.1	7 Reentry, Rescue, and Stabilization 7.1 All activities associated with reentry, rescue, and stabilization shall be coordinated and authorized by the emergency coordinator. The emergency coordinator may delegate authority to other qualified individuals.						(+) CRIT FACILITIES	X	
18.06.743	ANS 8.23	7.2	7 Reentry, Rescue, and Stabilization 7.2 Reentry shall be planned to minimize risks to personnel. The possibility of a continuing or recurring criticality accident shall be considered						(+) CRIT FACILITIES	X	
18.06.744	ANS 8.23	7.3	7 Reentry, Rescue, and Stabilization 7.3 Reentry during the emergency shall only be made by personnel trained in emergency response and reentry.						(+) CRIT FACILITIES	X	
18.06.745	ANS 8.23	7.4	7 Reentry, Rescue, and Stabilization 7.4 Personnel who reenter the immediate evacuation zone during the emergency shall be informed of the potential hazards and shall choose to accept the associated risk. Reentry should be performed by more than one person						(+) CRIT FACILITIES	X	
18.06.746	ANS 8.23	7.5	7 Reentry, Rescue, and Stabilization 7.5 Reentry should be made only if a preliminary radiological survey indicates that the radiation levels are acceptable for reentry. Existing instrumentation or temporary sensors with remote readout may be used.						(+) CRIT FACILITIES	X	
18.06.747	ANS 8.23	7.6	7 Reentry, Rescue, and Stabilization 7.6 All reentries shall be made with continuous radiation monitoring. Both neutron and gamma instruments should be used.						(+) CRIT FACILITIES	X	

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18.06.748	ANS 8.23	7.7	7 Reentry, Rescue, and Stabilization 7.7 If personnel need to be rescued, the rescue shall be planned so as not to expose rescuers to life-threatening radiation doses.						(+) CRIT FACILITIES	X	
18.06.749	ANS 8.23	7.8	7 Reentry, Rescue, and Stabilization 7.8 If the system remains critical and is possibly causing excessive damage or significant releases of radioactive material, an early reentry effort to disable the system may be permitted. The method for disabling the system shall be carefully planned and implemented to minimize risks to the reentry team.						(+) CRIT FACILITIES	X	
18.06.750	ANS 8.23	7.9	7 Reentry, Rescue, and Stabilization 7.9 The technical staff shall determine if the system is subcritical and shall advise management of methods to ensure stabilization of affected equipment and safe conditions for personnel. This might include placing the fissile material in a favorable geometry, diluting the fissile solution below a critical concentration, or using neutron absorbers to maintain subcriticality.						(+) CRIT FACILITIES	X	
18.06.751	ANS 8.23	7.10	7 Reentry, Rescue, and Stabilization 7.10 If use of neutron absorbers is planned to shut down or stabilize a system, a sufficient quantity of absorbers shall be readily available. Prior to being selected for use, the effect of the neutron absorbers under accident conditions shall be evaluated. Consideration shall be given to material compatibility and to cases under which addition of the neutron absorber can increase system neutron multiplication. Additional relevant information may be obtained from American National Standard “Use of Fixed Neutron Absorbers in Nuclear Facilities Outside Reactors,” ANS-8.21-1995 (R2011)and “Emergency Stock of Neutron Absorbers to Shut Down Self-Sustained Chain Reaction in Solutions of Fissile Materials. Note: ANS-8.21-1995 is found in this Functional Area as Requirements 18.06.601 through 18.06.627.						(+) CRIT FACILITIES	X	

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18.06.752	ANS 8.23	8.1	8 Classroom training, exercises, and evacuation drills 8.1 Classroom training A program of training for response to a criticality accident shall be developed and provided annually in accordance with American National Standard "Nuclear Criticality Safety Training," ANS-8.20-1991 (R2005). This training shall be reviewed annually, and as needed, to ensure that appropriate changes or modifications are incorporated into the training program. Other instructional formats, such as computer-based training, may be used to satisfy these requirements. Note: ANS-8.20-1991 is found in this Functional Area as Requirements 18.06.551 through 18.06.564.						(+) CRIT FACILITIES	X	
18.06.753	ANS 8.23	8.1.1	8 Classroom training, exercises, and evacuation drills 8.1 Classroom training 8.1.1 Facility personnel who must respond to a criticality accident alarm shall be trained to recognize the alarm and to know the facility layout, evacuation routes, personnel assembly station locations, and personnel accountability and monitoring methods. Training should emphasize that emergency actions, including evacuation, should be performed in a manner to reduce risk of injury.						(+) CRIT FACILITIES	X	
18.06.754	ANS 8.23	8.1.2	8 Classroom training, exercises, and evacuation drills 8.1 Classroom training 8.1.2 Emergency response personnel shall be trained on their specific duties and responsibilities to respond to a criticality accident. This training shall include procedures, facility layout, and characteristics of a criticality accident.						(+) CRIT FACILITIES	X	
18.06.755	ANS 8.23	8.1.3	8 Classroom training, exercises, and evacuation drills 8.1 Classroom training 8.1.3 Visitors shall be briefed on their responsibilities in responding to a criticality accident alarm or criticality accident.						(+) CRIT FACILITIES	X	

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18.06.756	ANS 8.23	8.1.4	8 Classroom training, exercises, and evacuation drills 8.1 Classroom training 8.1.4 Training on reentry procedures and facility hazards shall be provided annually for reentry team personnel.						(+) CRIT FACILITIES	X	
18.06.757	ANS 8.23	8.1.5	8 Classroom training, exercises, and evacuation drills 8.1 Classroom training 8.1.5 Technical staff shall be trained in their duties and responsibilities in the event of a criticality accident.						(+) CRIT FACILITIES	X	
18.06.758	ANS 8.23	8.2	8 Classroom training, exercises, and evacuation drills 8.2 Exercises A criticality accident response exercise should be conducted annually to test the capabilities of the emergency organizations and communication system and to reinforce emergency training. Exercises may include a drill.						(+) CRIT FACILITIES	X	
18.06.759	ANS 8.23	8.2.1	8 Classroom training, exercises, and evacuation drills 8.2 Exercises 8.2.1 Exercises should include a realistic scenario involving a simulated criticality accident. Exercises shall have defined objectives that specify the aspects of emergency response selected for testing or reinforcing.						(+) CRIT FACILITIES	X	
18.06.760	ANS 8.23	8.2.2	8 Classroom training, exercises, and evacuation drills 8.2 Exercises 8.2.2 Exercises should include a post-exercise critique involving observers, controllers, and representative participants.						(+) CRIT FACILITIES	X	
18.06.761	ANS 8.23	8.2.3	8 Classroom training, exercises, and evacuation drills 8.2 Exercises 8.2.3 Exercises should be planned and controlled by personnel who are not direct participants (players) in the exercise.						(+) CRIT FACILITIES	X	

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18.06.762	ANS 8.23	8.2.4	8 Classroom training, exercises, and evacuation drills 8.2 Exercises 8.2.4 Emergency response personnel should participate in nuclear criticality accident exercises to update and reinforce their previous response training.						(+) CRIT FACILITIES	X	
18.06.763	ANS 8.23	8.3	8 Classroom training, exercises, and evacuation drills 8.3 Evacuation drills Evacuation drills shall be conducted at least annually. Drills should be scheduled to include all personnel who routinely work within the immediate evacuation zone. The drills shall be preannounced (for example, by written notice, posted signs, or public address announcement) to minimize the possibility that accident or injury could result. If the response tests the same evacuation practices as used for a criticality accident, an evacuation drill may involve a scenario other than a criticality accident. A response to a false alarm should not be substituted for a drill, unless the required actions are to be observed or demonstrated.						(+) CRIT FACILITIES	X	
18.06.801	ANS 8.24	4.0	Computer code system **The computer code system to be validated shall be placed under an appropriate configuration control program.** **Verification of the computer code system shall be completed prior to validation.**						(+) CRIT FACILITIES	X	
18.06.802	ANS 8.24	5.1	Selection and modeling of benchmarks Appropriate system or process parameters that correlate the experiments to the system**(s)** or process**(es)** under consideration shall be identified. (See Appendix A for example physical and derived parameters.) **Automated selection systems that consider the isotopes, their abundances, energy ranges, cross-section uncertainties, or other parameters may be used.** Note: For Appendix A see the Source Document (ANS 8.24).						(+) CRIT FACILITIES	X	

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18.06.803	ANS 8.24	5.2	Selection and modeling of benchmarks **If the validation is being developed for a specific system(s) or process(es), n**ormal and credible abnormal conditions for the system**(s)** or process**(es)** shall be identified when determining the appropriate parameters and their range of values. **If the validation is more general in nature, the appropriateness of the validation shall be assessed and documented for the normal and credible abnormal conditions of the system(s) being evaluated.**						(+) CRIT FACILITIES	X	
18.06.804	ANS 8.24	5.3	Selection and modeling of benchmarks **Selected benchmarks should, in aggregate, encompass the appropriate parameter values spanning the range of normal and credible abnormal conditions for the system or process to which the validation will be applied.**						(+) CRIT FACILITIES	X	
18.06.805	ANS 8.24	5.4	Selection and modeling of benchmarks **Experiments shall be reviewed for completeness and accuracy of information prior to use as benchmarks. (See Appendix B for several sources of information on experiments.)** **Note: For Appendix B see the Source Document (ANS 8.24).**						(+) CRIT FACILITIES	X	
18.06.806	ANS 8.24	5.5	Selection and modeling of benchmarks Benchmarks selected should be consistent with the modeling capabilities of the calculational method.						(+) CRIT FACILITIES	X	
18.06.807	ANS 8.24	5.6	Selection and modeling of benchmarks To minimize systematic error, benchmarks should be drawn from multiple, independent experimental series.						(+) CRIT FACILITIES	X	
18.06.808	ANS 8.24	5.7	Selection and modeling of benchmarks The calculational methods and analysis techniques used to analyze the set of benchmarks **should** be the same as those used to analyze the system or process to which the validation is applied **or justification shall be provided for the different techniques**.						(+) CRIT FACILITIES	X	
18.06.809	ANS 8.24	5.8	Selection and modeling of benchmarks Modeling of benchmarks shall be the responsibility of individuals experienced in the use of the **computer code system**.						(+) CRIT FACILITIES	X	

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18.06.810	ANS 8.24	5.9	Selection and modeling of benchmarks Benchmark models prepared by organizations other than the one performing the validation should be evaluated to confirm the appropriateness of **calculational methods and analysis techniques** for the intended use.						(+) CRIT FACILITIES	X	
18.06.811	ANS 8.24	6.1.1 **– 6.1.2**	Establishment of bias, bias uncertainty, and margins **When no benchmark data are available, establishment of a calculational margin and upper subcritical limit (USL) is not possible within the requirements of this standard. Establishing a bias and bias uncertainty, calculational margin, and USL by comparing the results of one calculational method against another does not comply with this standard.** Methods and data **When limited benchmarks are available, other experimental data (e.g., cross-section differential data) may be used in the development of the appropriate bias uncertainty or margin of subcriticality. Sensitivity analysis may be used to determine the importance of specific nuclides to the system of interest.** **The quantity and quality of the data should be considered when selecting the method to be used in determining the bias and bias uncertainty to ensure the underlying requirements of the method are satisfied. The selection of the method should consider anticipated needs of the validation applicability (e.g., whether or not extrapolations or wide interpolations will be needed).**						(+) CRIT FACILITIES	X	

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S/RID Requirement Number	Source Document	Source Document Reqt Number	Requirement Text	SRR Applicability						Phase I Compliance	
				Nuclear HC-1,2,3	Radi-ological	High Hazard Chemical	Low Hazard Chemical	Other Industrial	Facility Specific	Common	Facility Specific
18.06.812	ANS 8.24	6.1.**3**	Establishment of bias, bias uncertainty, and margins **When no benchmark data are available, establishment of a calculational margin and upper subcritical limit (USL) is not possible within the requirements of this standard. Establishing a bias and bias uncertainty, calculational margin, and USL by comparing the results of one calculational method against another does not comply with this standard.** Methods and data If a positive bias is used in the determination of the calculational margin, its use shall be justified **by the close applicability of the benchmarks. If the justification cannot be made, the positive bias shall be removed using methods consistent with the statistical approach or through the use of an increased margin of subcriticality**. Note: The sign of the bias is arbitrary. For the purpose of this standard, it has been defined to be positive when the calculated values exceed the experimental values, but it could be defined otherwise.						(+) CRIT FACILITIES	X	
18.06.813	ANS 8.24	6.1.**4**	Establishment of bias, bias uncertainty, and margins **When no benchmark data are available, establishment of a calculational margin and upper subcritical limit (USL) is not possible within the requirements of this standard. Establishing a bias and bias uncertainty, calculational margin, and USL by comparing the results of one calculational method against another does not comply with this standard.** Methods and data The determination of bias uncertainty should contain allowances for uncertainties in benchmark physical properties and measurement techniques; uncertainties due to limitations in the geometric, material, or neutronic representations (e.g., cross sections) used in a calculational model; and statistical and convergence uncertainties.						(+) CRIT FACILITIES	X	

TABLE 1 - S/RID FUNCTIONAL AREA 18 (NUCLEAR AND PROCESS SAFETY) REQUIREMENTS

S/RID Requirement Number	Source Document	Source Document Reqt Number	Requirement Text	SRR Applicability						Phase I Compliance	
				Nuclear HC-1,2,3	Radi-ological	High Hazard Chemical	Low Hazard Chemical	Other Industrial	Facility Specific	Common	Facility Specific
18.06.814	ANS 8.24	6.1.5	Establishment of bias, bias uncertainty, and margins **When no benchmark data are available, establishment of a calculational margin and upper subcritical limit (USL) is not possible within the requirements of this standard. Establishing a bias and bias uncertainty, calculational margin, and USL by comparing the results of one calculational method against another does not comply with this standard.** Methods and data Individual elements (e.g., bias and bias uncertainty) of the calculational margin need not be computed separately. Methods may be used that combine the elements into the calculational margin.						(+) CRIT FACILITIES	X	
18.06.815	ANS 8.24	6.1.6	Establishment of bias, bias uncertainty, and margins **When no benchmark data are available, establishment of a calculational margin and upper subcritical limit (USL) is not possible within the requirements of this standard. Establishing a bias and bias uncertainty, calculational margin, and USL by comparing the results of one calculational method against another does not comply with this standard.** Methods and data While statistical methods are typically used in the determination of the calculational margin, nonstatistical methods may be used where appropriate. (References to various methods are provided in Appendix C.) Note: For Appendix C see the Source Document (ANS 8.24).						(+) CRIT FACILITIES	X	

TABLE 1 - S/RID FUNCTIONAL AREA 18 (NUCLEAR AND PROCESS SAFETY) REQUIREMENTS

S/RID Requirement Number	Source Document	Source Document Reqt Number	Requirement Text	SRR Applicability						Phase I Compliance	
				Nuclear HC-1,2,3	Radi-ological	High Hazard Chemical	Low Hazard Chemical	Other Industrial	Facility Specific	Common	Facility Specific
18.06.816	ANS 8.24	6.2	**Establishment of bias, bias uncertainty, and margins** **When no benchmark data are available, establishment of a calculational margin and upper subcritical limit (USL) is not possible within the requirements of this standard. Establishing a bias and bias uncertainty, calculational margin, and USL by comparing the results of one calculational method against another does not comply with this standard.** Trending Trends **in the bias and bias uncertainty** may be considered. Parameters chosen for trending shall be based on the characteristics of the system**(s)** or process**(es)** under consideration. Trends in **bias and bias uncertainty** used for extrapolation or for wide interpolation (e.g., gaps between groups of data) should be based on an understanding of the **physical** causes of such trends.						(+) CRIT FACILITIES	X	
18.06.817	ANS 8.24	6.3	**Establishment of bias, bias uncertainty, and margins** **When no benchmark data are available, establishment of a calculational margin and upper subcritical limit (USL) is not possible within the requirements of this standard. Establishing a bias and bias uncertainty, calculational margin, and USL by comparing the results of one calculational method against another does not comply with this standard.** Weighting and rejection of data Data may be weighted to account for benchmark uncertainties or other indications of benchmark quality (e.g., degree of characterization or degree of applicability). **Identification of data outliers may be based on established statistical rejection methods; r**ejection of outliers shall be based on the inconsistency of the data with known physical behavior **in the experimental data**.						(+) CRIT FACILITIES	X	

TABLE 1 - S/RID FUNCTIONAL AREA 18 (NUCLEAR AND PROCESS SAFETY) REQUIREMENTS

S/RID Requirement Number	Source Document	Source Document Reqt Number	Requirement Text	SRR Applicability						Phase I Compliance	
				Nuclear HC-1,2,3	Radi-ological	High Hazard Chemical	Low Hazard Chemical	Other Industrial	Facility Specific	Common	Facility Specific
18.06.818	ANS 8.24	6.4	**Establishment of bias, bias uncertainty, and margins** **When no benchmark data are available, establishment of a calculational margin and upper subcritical limit (USL) is not possible within the requirements of this standard. Establishing a bias and bias uncertainty, calculational margin, and USL by comparing the results of one calculational method against another does not comply with this standard.** Margin of subcriticality. A margin of subcriticality shall be applied that is sufficiently large to ensure that calculated conditions will actually be subcritical. **The margin should be based on the quantity and quality of the benchmarks and similarity to the system(s) to be evaluated.** The selection of a margin of subcriticality **may** take into account the sensitivity of the system or process to variations in fissile form, geometry, or other physical characteristics**, or sensitivity/uncertainty analysis**. A single margin might not be appropriate over the entire **range of the** validation applicability.						(+) CRIT FACILITIES	X	
18.06.819	ANS 8.24	7.0	**Applicability** of the validation The validation applicability shall be established based on the benchmark applicability and may be **extended beyond the benchmark applicability** to allow for extrapolation and wide interpolation of the **benchmark** data. The validation applicability should not be so large that a subset of the data with a high degree of similarity to the system or process would produce a **USL** that is lower than that determined for the entire set. This criterion is recommended to ensure that a subset of data that is closely related to the system or process is not nonconservatively masked by benchmarks that do not match the system as well. A **USL** shall be established based on the calculational margin and the margin of subcriticality.						(+) CRIT FACILITIES	X	

TABLE 1 - S/RID FUNCTIONAL AREA 18 (NUCLEAR AND PROCESS SAFETY) REQUIREMENTS

S/RID Requirement Number	Source Document	Source Document Reqt Number	Requirement Text	SRR Applicability						Phase I Compliance	
				Nuclear HC-1,2,3	Radi-ological	High Hazard Chemical	Low Hazard Chemical	Other Industrial	Facility Specific	Common	Facility Specific
18.06.820	ANS 8.24	8.1.1	Documentation and independent technical review The validation activity shall be documented with sufficient detail to allow for independent technical review. (See Note) The computer code system being validated shall be described. Note: See Appendix D which is found in this Source Document (ANS 8.24) for an example of the validation process.						(+) CRIT FACILITIES	X	
18.06.821	ANS 8.24	8.1.2	Documentation and independent technical review The validation activity shall be documented with sufficient detail to allow for independent technical review. A justification for the selection of the benchmarks used in conducting the validation shall be presented along with identification of the data sources through appropriate references. The benchmark applicability shall be documented.						(+) CRIT FACILITIES	X	
18.06.822	ANS 8.24	8.1.3	Documentation and independent technical review The validation activity shall be documented with sufficient detail to allow for independent technical review. The methods and calculations supporting the determination of the bias and bias uncertainty, the calculational margin, and the validation applicability shall be documented. If used, the trending analysis and its technical bases shall be documented. **If used, weighting of the data shall be documented.**						(+) CRIT FACILITIES	X	
18.06.823	ANS 8.24	8.1.4	Documentation and independent technical review The validation activity shall be documented with sufficient detail to allow for independent technical review. The validation applicability shall be documented including the justification for any extrapolations or any wide interpolations beyond the bounds of the benchmark applicability. Differences between the validation applicability and the system or process parameters shall be discussed and justified. Limitations of the validation (e.g., gaps in the data, **correlation between benchmarks**, missing or limited data) shall be described.						(+) CRIT FACILITIES	X	

TABLE 1 - S/RID FUNCTIONAL AREA 18 (NUCLEAR AND PROCESS SAFETY) REQUIREMENTS

S/RID Requirement Number	Source Document	Source Document Reqt Number	Requirement Text	SRR Applicability						Phase I Compliance	
				Nuclear HC-1,2,3	Radi-ological	High Hazard Chemical	Low Hazard Chemical	Other Industrial	Facility Specific	Common	Facility Specific
18.06.824	ANS 8.24	8.1.5	Documentation and independent technical review The validation activity shall be documented with sufficient detail to allow for independent technical review. The margin of subcriticality and its basis shall be documented.						(+) CRIT FACILITIES	X	
18.06.825	ANS 8.24	8.1.6	Documentation and independent technical review The validation activity shall be documented with sufficient detail to allow for independent technical review. The **USL** shall be documented.						(+) CRIT FACILITIES	X	
18.06.826	ANS 8.24	8.2	Documentation and independent technical review An independent technical review of the validation shall be performed. The independent technical review **shall, as a minimum,** include the following: (1) a review of the benchmark applicability; (2) a review of the input files and output files to ensure accurate modeling and adequate convergence; (3) a review of the methodology, and its use, for determining bias, bias uncertainty, and margins; (4) concurrence with the validation applicability.						(+) CRIT FACILITIES	X	

TABLE 1 - S/RID FUNCTIONAL AREA 18 (NUCLEAR AND PROCESS SAFETY) REQUIREMENTS

S/RID Requirement Number	Source Document	Source Document Reqt Number	Requirement Text	SRR Applicability						Phase I Compliance	
				Nuclear HC-1,2,3	Radi-ological	High Hazard Chemical	Low Hazard Chemical	Other Industrial	Facility Specific	Common	Facility Specific
18.06.851	ANS 8.26	4.1	Management responsibilities Training and qualification program ANSI/ANS-8.19-2005 [2] requires management to establish a training and qualification program for nuclear criticality safety staff. The program shall include requirements for demonstration that competency in the content elements listed in Sec. 7 has been achieved. At the discretion of management, certain requirements of Sec. 7 may be deferred until the resources required to meet those requirements are available. (Note 2) In such cases, provisional qualification may be given to the criticality safety engineer until the deferred training is completed. Such deferrals shall be provided for in the training program document and recorded in the criticality safety engineer's training record. Notes: 1. ANS-8.19-2005 has been replaced by ANS-8.19-2014 and is included in this Functional Area as Requirements 18.06.501 through 18.06.546. 2. For example, if the hands-on training requirement of Sec. 7.4 cannot be met because a suitable course is not available, provisional qualification can be granted that allows an individual to function as a qualified criticality safety engineer until such time that a course is available.						(+) CRIT FACILITIES	X	
18.06.852	ANS 8.26	4.2	Management responsibilities Program review. The effectiveness of the criticality safety engineer training and qualification program shall be reviewed periodically. The interval between reviews shall not exceed three years. Management shall ensure that such reviews are conducted and documented.						(+) CRIT FACILITIES	X	

TABLE 1 - S/RID FUNCTIONAL AREA 18 (NUCLEAR AND PROCESS SAFETY) REQUIREMENTS

S/RID Requirement Number	Source Document	Source Document Reqt Number	Requirement Text	SRR Applicability						Phase I Compliance	
				Nuclear HC-1,2,3	Radi-ological	High Hazard Chemical	Low Hazard Chemical	Other Industrial	Facility Specific	Common	Facility Specific
18.06.853	ANS 8.26	5.0	Criticality safety engineer qualification levels Three levels of criticality safety engineer qualification are defined by this standard. Qualification to these levels shall be achieved by participation in a training and qualification program that encompasses the content elements given in Sec. 7 of this standard. The following sections summarize the qualification criteria for the three categories of criticality safety engineers. 5.1 Criticality safety engineer. A criticality safety engineer shall have successfully completed training with commensurate documentation in each of the content areas listed in Sec. 7 of this standard according to the training and qualification program. 5.2 Criticality safety engineer in training. A criticality safety engineer in training is one who is actively training in the areas listed in Sec. 7 of this standard. During this period, the criticality safety engineer in training shall perform tasks only under the supervision of one or more criticality safety engineers. 5.3 Senior criticality safety engineer. A senior criticality safety engineer shall meet all qualification requirements of a criticality safety engineer. A senior criticality safety engineer should have broad experience in criticality safety and related fields, including independent review of NCSEs, mentoring criticality safety engineers in training, and oversight of operations with criticality control materials (e.g., fissionable materials, moderators, absorbers). Note: Requirements of Sec. 7 are included in this Functional Area as Requirements 18.06.857 through 18.06.866.						(+) CRIT FACILITIES	X	
18.06.854	ANS 8.26	6.1	Training and qualification program Guidelines for qualification of criticality safety engineers in training. The preferred method of training for persons entering the field of criticality safety should be to work closely with a senior criticality safety engineer as they complete the training program. 6.1.1 Academic training may be used to satisfy certain training and qualification requirements (e.g., analysis methods). When such training is used as the basis for meeting any of the established requirements, documentation shall be included in the training and qualification records.						(+) CRIT FACILITIES	X	

TABLE 1 - S/RID FUNCTIONAL AREA 18 (NUCLEAR AND PROCESS SAFETY) REQUIREMENTS

S/RID Requirement Number	Source Document	Source Document Reqt Number	Requirement Text	SRR Applicability						Phase I Compliance	
				Nuclear HC-1,2,3	Radi-ological	High Hazard Chemical	Low Hazard Chemical	Other Industrial	Facility Specific	Common	Facility Specific
18.06.855	ANS 8.26	6.2	Training and qualification program Guidelines for qualification of experienced criticality safety engineers. Active criticality safety engineers may satisfy some qualification criteria in Sec. 7 based on experience provided that their qualification has been verified and documented according to the requirements of the training and qualification program. 6.2.1 Past experience in the field of criticality safety may be used to satisfy training and qualification requirements. When experience is used as the basis for meeting any of the established requirements, documentation supporting such qualification shall be included in the training and qualification records. 6.2.2 Experienced personnel shall obtain site, facility, and process familiarity in accordance with specific site, facility, or process requirements before being qualified to independently perform work at that site or facility or with that process. 6.2.3 The qualification requirement to maintain familiarity with a site, facility, or process shall include walk downs led by both operations and criticality safety engineers familiar with the site, facility, or process; review of existing NCSEs, limits, and controls; and review of emergency procedures. To the extent practicable, it should include discussions of the major criticality safety risks associated with the site, facility, or process with a cognizant criticality safety engineer. 6.2.4 Past experience on different processes shall not be used solely to satisfy familiarity requirements with local facilities and/or processes. Note: Requirements of Sec. 7 are included in this Functional Area as Requirements 18.06.857 through 18.06.866.						(+) CRIT FACILITIES	X	

TABLE 1 - S/RID FUNCTIONAL AREA 18 (NUCLEAR AND PROCESS SAFETY) REQUIREMENTS

S/RID Requirement Number	Source Document	Source Document Reqt Number	Requirement Text	SRR Applicability						Phase I Compliance	
				Nuclear HC-1,2,3	Radi-ological	High Hazard Chemical	Low Hazard Chemical	Other Industrial	Facility Specific	Common	Facility Specific
18.06.856	ANS 8.26	6.3	Training and qualification program Maintaining qualification. The requirements for maintaining qualification as a criticality safety engineer or senior criticality safety engineer shall be established by management as part of the training and qualification program. Maintenance of qualification should include the following: (1) re-qualification according to the facility specific training and qualification program requirements; (2) continued active participation in the development of NCSEs; (3) continued active participation in the independent review of NCSEs (senior criticality safety engineers); (4) continued professional development through participation at professional meetings or societies (e.g., technical sessions, technical papers, committees, development of consensus standards, workshops, or tutorials).						(+) CRIT FACILITIES	X	
18.06.857	ANS 8.26	7. 1	General training and qualification content areas. Each of the following content areas shall be addressed in the training and qualification program. Documentation of completion of training in each area shall be maintained by facility management as part of the program. Degree and educational background. Criticality safety engineers shall have: (1) a minimum educational background of a baccalaureate degree in science or engineering from an accredited college or university (preferred alternative) or (2) at least five years of directly applicable experience or (3) an equivalent combination of education and experience.						(+) CRIT FACILITIES	X	
18.06.858	ANS 8.26	7. 2	General training and qualification content areas. Each of the following content areas shall be addressed in the training and qualification program. Documentation of completion of training in each area shall be maintained by facility management as part of the program. Methods. Criticality safety engineers shall be trained in a broad range of methods used in support of criticality safety that can include application of handbook values, direct use of benchmark data, simple hand calculations, use of empirically derived formulas, and complex multidimensional deterministic and/or Monte Carlo calculations. Proficiency in using specific methods should be demonstrated while in training.						(+) CRIT FACILITIES	X	

TABLE 1 - S/RID FUNCTIONAL AREA 18 (NUCLEAR AND PROCESS SAFETY) REQUIREMENTS

S/RID Requirement Number	Source Document	Source Document Reqt Number	Requirement Text	SRR Applicability						Phase I Compliance	
				Nuclear HC-1,2,3	Radi-ological	High Hazard Chemical	Low Hazard Chemical	Other Industrial	Facility Specific	Common	Facility Specific
18.06.859	ANS 8.26	7. 3	General training and qualification content areas. Each of the following content areas shall be addressed in the training and qualification program. Documentation of completion of training in each area shall be maintained by facility management as part of the program. Critical experiments and data. Criticality safety engineers shall be able to relate the results of critical and subcritical experiments, available nuclear data (e.g., cross sections), and lessons learned from past criticality accidents to facility operations for which they prepare NCSEs.						(+) CRIT FACILITIES	X	
18.06.860	ANS 8.26	7. 4	General training and qualification content areas. Each of the following content areas shall be addressed in the training and qualification program. Documentation of completion of training in each area shall be maintained by facility management as part of the program. Hands-on experiments. Criticality safety engineers shall participate, or shall have participated in the past based on education, experience, or training, in the conduct and interpretation of critical experiments in hands-on classes that demonstrate how varying the properties of a fissionable material system can affect neutron multiplication. These hands-on classes may be held, or may have been held in the past, either at a critical experiment's facility or at a research reactor.						(+) CRIT FACILITIES	X	
18.06.861	ANS 8.26	7. 5	General training and qualification content areas. Each of the following content areas shall be addressed in the training and qualification program. Documentation of completion of training in each area shall be maintained by facility management as part of the program. Rules, standards, and guides. Criticality safety engineers shall have an understanding of the industry standards, regulatory requirements, and guidance applicable to their facilities and operations. Demonstration of this knowledge should be included in the training and qualification program requirements.						(+) CRIT FACILITIES	X	
18.06.862	ANS 8.26	7. 6	General training and qualification content areas. Each of the following content areas shall be addressed in the training and qualification program. Documentation of completion of training in each area shall be maintained by facility management as part of the program. Nuclear criticality safety evaluations. Criticality safety engineers shall demonstrate competency, with commensurate documentation, in preparing NCSEs. To the extent practical, the criticality safety engineer in training should complete several NCSEs under the close supervision of a criticality safety engineer or senior criticality safety engineer.						(+) CRIT FACILITIES	X	

TABLE 1 - S/RID FUNCTIONAL AREA 18 (NUCLEAR AND PROCESS SAFETY) REQUIREMENTS

S/RID Requirement Number	Source Document	Source Document Reqt Number	Requirement Text	SRR Applicability						Phase I Compliance	
				Nuclear HC-1,2,3	Radi-ological	High Hazard Chemical	Low Hazard Chemical	Other Industrial	Facility Specific	Common	Facility Specific
18.06.863	ANS 8.26	7. 7	General training and qualification content areas. Each of the following content areas shall be addressed in the training and qualification program. Documentation of completion of training in each area shall be maintained by facility management as part of the program. Safety analyses and controls. Criticality safety engineers shall demonstrate competency in integrating nuclear criticality safety into facility safety analyses. 7.7.1 Criticality safety engineers shall have knowledge, supported by commensurate documentation, of hazards identification and safety analysis methods, and should be able to integrate identified hazards into the NCSEs. 7.7.2 Criticality safety engineers shall be able to generate the appropriate input, evidenced by documentation, to sections of authorization basis documents (e.g., documented safety analyses, safety analysis reports) that deal with criticality safety. 7.7.3 Criticality safety engineers shall work with the facility or site safety basis organization to incorporate criticality safety controls as appropriate into facility operating requirements, and to verify that local management systems ensure the implementation and continued availability of established criticality safety controls.						(+) CRIT FACILITIES	X	
18.06.864	ANS 8.26	7. 8	General training and qualification content areas. Each of the following content areas shall be addressed in the training and qualification program. Documentation of completion of training in each area shall be maintained by facility management as part of the program. Criticality alarm systems. Criticality safety engineers should demonstrate the competency necessary to support deployment, operation, and removal of criticality accident alarm systems at facilities where these systems are in use.						(+) CRIT FACILITIES	X	

TABLE 1 - S/RID FUNCTIONAL AREA 18 (NUCLEAR AND PROCESS SAFETY) REQUIREMENTS

S/RID Requirement Number	Source Document	Source Document Reqt Number	Requirement Text	SRR Applicability						Phase I Compliance	
				Nuclear HC-1,2,3	Radi-ological	High Hazard Chemical	Low Hazard Chemical	Other Industrial	Facility Specific	Common	Facility Specific
18.06.865	ANS 8.26	7. 9	General training and qualification content areas. Each of the following content areas shall be addressed in the training and qualification program. Documentation of completion of training in each area shall be maintained by facility management as part of the program. Material accountability and nondestructive analysis practices. Criticality safety engineers should demonstrate understanding of special nuclear material accountability programs and their interaction(s) with criticality safety program(s), and the extent to which accountability data or process controls may be used as criticality safety controls, including the capabilities and limitations of processes or equipment used to measure and/or monitor fissionable material (e.g., accuracy and uncertainty of measuring/monitoring equipment).						(+) CRIT FACILITIES	X	
18.06.866	ANS 8.26	7.10	General training and qualification content areas. Each of the following content areas shall be addressed in the training and qualification program. Documentation of completion of training in each area shall be maintained by facility management as part of the program. Process and facility knowledge. Criticality safety engineers shall maintain familiarity with assigned operations, equipment, material processes, physical plant equipment or systems, and the safety authorization bases, including passive, active, and administrative control requirements, of their facilities. To the extent practical, this knowledge should be acquired by spending time in the operating areas of the facilities assigned to the criticality safety engineer.						(+) CRIT FACILITIES	X	
18.06.867	ANS 8.26	8.0	Documentation of the training and qualification program 8.1 Management shall document the training and qualification program including requirements for (a) qualification of personnel new to the criticality safety discipline, (b) qualification of experienced criticality safety engineers, and (c) re-qualification on a periodic basis. 8.2 Records shall be maintained for each individual earning and maintaining criticality safety engineer qualification and shall be retained in accordance with established management procedures.						(+) CRIT FACILITIES	X	

TABLE 1 - S/RID FUNCTIONAL AREA 18 (NUCLEAR AND PROCESS SAFETY) REQUIREMENTS

S/RID Requirement Number	Source Document	Source Document Reqt Number	Requirement Text	SRR Applicability						Phase I Compliance	
				Nuclear HC-1,2,3	Radi-ological	High Hazard Chemical	Low Hazard Chemical	Other Industrial	Facility Specific	Common	Facility Specific
18.06.901	ANS 8.27	4	Criteria to establish subcriticality The calculated multiplication factor kp plus allowances for biases and uncertainties shall be equal to or less than an established, allowable neutron multiplication factor; i.e., kp +Δ kp +Δ ki + Δkb ≤ kc – Δkc – Δkx -Δ km, (Eq. 1) where: kp is the calculated multiplication factor of the model for the system being evaluated. The kp shall include a bias correction if there is a negative bias due to modeling issues not addressed in the other terms; Note: See ANS-8.27 for specific formula formatting						(+) CRIT FACILITIES	X	
18.06.902	ANS 8.27	4(1)	Criteria to establish subcriticality (Continued) 4(1) Δkp is an allowance for • statistical or convergence uncertainties, or both, in the determination of kp, • material and fabrication tolerances, • uncertainties due to geometric or material representation limitations of the models used in the determination of kp; Note: See ANS-8.27 for specific formula formatting						(+) CRIT FACILITIES	X	
18.06.903	ANS 8.27	4(2)	Criteria to establish subcriticality (Continued) 4(2) Δki is an allowance for the bias and uncertainty in kp due to depletion uncertainty in the calculated nuclide compositions. Δki may be zero if the nuclide compositions are determined in a manner that assures a bounding neutron multiplication factor kp. See Sec. 5 for more information; Note: See ANS-8.27 for specific formula formatting						(+) CRIT FACILITIES	X	

TABLE 1 - S/RID FUNCTIONAL AREA 18 (NUCLEAR AND PROCESS SAFETY) REQUIREMENTS

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18.06.904	ANS 8.27	4(3)	Criteria to establish subcriticality (Continued) 4(3) Δkb is an allowance for uncertainty in kp due to uncertainty in the assigned burnup value. Δkb may be zero if it is accounted for by a reduction in the assigned burnup value as described in Sec. 7.~~1~~2. Also, Δkb may be zero in burnable absorber credit when the maximum multiplication factor during irradiation is used in the criticality safety evaluation. Note: See ANS-8.27 for specific formula formatting						(+) CRIT FACILITIES	X	
18.06.905	ANS 8.27	4(4)	Criteria to establish subcriticality (Continued) 4(4) kc is the multiplication factor that results from the calculation of the benchmark criticality experiments using a particular calculation method and nuclear cross-section data. The criticality experiments used as benchmarks in determining kc should have physical compositions, configurations, and nuclear characteristics similar to those of the system being evaluated. If the system being evaluated has parameter(s) beyond the area of applicability established by the benchmark criticality experiments (i.e., the benchmark applicability), then the benchmark applicability may be extended by using trends in the calculated values of kc with the parameter(s). For large extensions, the use of trends should be supplemented by use of other calculation methods. The term kc accounts for the bias relative to the benchmark criticality experiments (the bias equals kc - 1). See **ANSI/**ANS-8.24-2007 **(R2012)** for further requirements and recommendations on the benchmark applicability and extension beyond the benchmark applicability. Also, see Sec. 5 for more information on the relationship between kc and Δkx; Notes: 1) See ANS-8.27 for specific formula formatting **2) When the benchmark keff value does not equal 1.0, then a normalized calculation keff value should be used to establish trends and extensions to the benchmark applicability.** **3) ANSI/**ANS-8.24-2007 **(R2012) has been replaced by ANSI/ANS-8.24-2017**. The validation requirements of Section 4.3 have been replaced by the requirements of ANS-8.24-2007. ANS 8.24 is found in this Functional Area as Requirements 18.06.801 through 18.06.826.						(+) CRIT FACILITIES	X	

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18.06.906	ANS 8.27	4(5)	Criteria to establish subcriticality (Continued) 4(5) Δkc is an allowance for uncertainty in kc that includes • statistical or convergence uncertainties, or both, in the computation of kc, • uncertainties in the benchmark criticality experiments, • uncertainties due to extrapolation of kc outside the range of experimental data (e.g., laboratory benchmark criticality experiments with well-characterized irradiated fuel could be limited), • uncertainties due to geometric or material representation limitations of the models used in the determination of kc; Note: See ANS-8.27 for specific formula formatting						(+) CRIT FACILITIES	X	
18.06.907	ANS 8.27	4(6)	Criteria to establish subcriticality (Continued) 4(6) Δkx is a potential supplement to kc and/or Δkc that may be included to provide an allowance for the bias and uncertainty from nuclide cross-section data that might not be adequately accounted for in the benchmark criticality experiments used for kc. The value of Δkx shall be established using experimental data (e.g., individual isotope worth experiments). The term may be included partially or completely in kc and/or Δkc but is included here to assure recognition of and to account for potential sources of additional bias and uncertainty; Note: See ANS-8.27 for specific formula formatting						(+) CRIT FACILITIES	X	

TABLE 1 - S/RID FUNCTIONAL AREA 18 (NUCLEAR AND PROCESS SAFETY) REQUIREMENTS

S/RID Requirement Number	Source Document	Source Document Reqt Number	Requirement Text	SRR Applicability						Phase I Compliance	
				Nuclear HC-1,2,3	Radi-ological	High Hazard Chemical	Low Hazard Chemical	Other Industrial	Facility Specific	Common	Facility Specific
18.06.908	ANS 8.27	4(7)	Criteria to establish subcriticality (Continued) 4(7) Δkm is a margin for unknown uncertainties and deemed to be adequate to ensure subcriticality of the physical system being modeled. Notes: 1) See ANS-8.27 for specific formula formatting 2) The validation requirements of Section 4.3 have been replaced by the requirements of ANS-8.24-2007. ANS 8.24 is found in this Functional Area as Requirements 18.06.801 through 18.06.826.						(+) CRIT FACILITIES	X	
18.06.909	ANS 8.27	4(8)	Criteria to establish subcriticality (Continued) 4(8) ANS-8.24-2007 **(R2012)** defines the right side of Eq. (1) as the upper subcritical limit. The terms in Eq. (1) contain allowances for biases and uncertainties. The statistical uncertainties (but not the biases) covered within each term (and sometimes in different terms) in Eq. (1) may be combined statistically with appropriate justification and consideration of correlations. ANSI/NCSL Z540-2-1997 (R**2012**), **"U.S. Guide to the Expression of Uncertainty in Measurement"** provides recommendations for treating some types of uncertainties. The Δkm term is not a statistical uncertainty and thus shall not be involved in a statistical combination of uncertainties. In one method of validation, Δki and Δkx are inseparable and are determined together. (See Sec. 5.2.) Note: See ANS-8.27 for specific formula formatting						(+) CRIT FACILITIES	X	

TABLE 1 - S/RID FUNCTIONAL AREA 18 (NUCLEAR AND PROCESS SAFETY) REQUIREMENTS

S/RID Requirement Number	Source Document	Source Document Reqt Number	Requirement Text	SRR Applicability						Phase I Compliance	
				Nuclear HC-1,2,3	Radi-ological	High Hazard Chemical	Low Hazard Chemical	Other Industrial	Facility Specific	Common	Facility Specific
18.06.910	ANS 8.27	5	5. Validation for burnup credit The methods of analysis used to determine the nuclide composition and the neutron multiplication factors shall be validated consistent with the requirements of this section. The validation of the burnup credit methodology may be accomplished by validation of each analysis component (i.e., analysis to determine the nuclide composition and analysis to determine the neutron multiplication factor) or by a combined validation approach where the bias and uncertainty terms from the individual analysis components are not determined individually. The extent to which an analysis relies on validation of the components separately or in combination shall be based on the application or intended use. Validation of the methods of analysis may also be accomplished by an approach where certain bias and uncertainty terms are determined for each analysis component and other bias and uncertainty terms are not separated by an analysis component. All of the bias and uncertainty terms noted in Sec. 4 shall be included either separately or combined as appropriate.						(+) CRIT FACILITIES	X	
18.06.911	ANS 8.27	5(1)	5. Validation for burnup credit (Continued) Traditional criticality safety application validation relies on experiments. In addition to experiments, other measurements from routine operation or incidents may be evaluated and documented as benchmarks for validation related to burnup credit. Because of differences between measurement conditions and the criticality safety application conditions, the uncertainty of the extrapolation of these data to the criticality safety application of burnup credit shall be quantified via calculation or additional experimental evidence.						(+) CRIT FACILITIES	X	
18.06.912	ANS 8.27	5.1	5. Validation for burnup credit (Continued) 5.1 Validation of analysis components Burnup credit validation by components requires two steps: the validation of the nuclide concentration and the validation of the criticality calculation covering the **nuclides** used in the criticality calculation.						(+) CRIT FACILITIES	X	

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18.06.913	ANS 8.27	5.1.1	5. Validation for burnup credit (Continued) 5.1 Validation of analysis components (Continued) 5.1.1 Validation of the nuclide composition analysis A depletion and decay analysis is used to determine the nuclide content for the subsequent determination of the neutron multiplication factor. The adequacy of the analysis for determining the nuclide compositions shall be demonstrated by comparison to measured data. The measured data shall be used in determining Δki.						(+) CRIT FACILITIES	X	
18.06.914	ANS 8.27	5.1.2	5. Validation for burnup credit (Continued) 5.1 Validation of analysis components (Continued) 5.1.2 Validation of the analysis used to determine kp After the nuclides for determining the neutron multiplication factor have been identified, the analysis methodology used to determine kp shall be validated using measured data resulting from critical or subcritical experiments. The terms kc and Δkc are determined using the same criteria as prescribed in **ANSI/**ANS-8.24-2007 **(R2012)**. Bias and uncertainty terms for nuclides included in the calculation of the neutron multiplication factor that are not adequately accounted for in benchmark criticality experiments shall be incorporated by determining Δkx using appropriate experimental data. Note: **ANSI/ANS-8.24-2007 (R2012) has been replaced by ANSI/ANS-8.24-2017**.The validation requirements of Section 4.3 have been replaced by the requirements of ANS-8.24-2007. ANS 8.24 is found in this Functional Area as Requirements 18.06.801 through 18.06.826.						(+) CRIT FACILITIES	X	

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				Nuclear HC-1,2,3	Radi-ological	High Hazard Chemical	Low Hazard Chemical	Other Industrial	Facility Specific	Common	Facility Specific
18.06.915	ANS 8.27	5.2	5. Validation for burnup credit (Continued) 5.2 Combined validation approach Validation of the burnup credit models (i.e., determination of nuclide composition and neutron multiplication factor) may be performed by analysis of applicable critical systems consisting of irradiated fuel with a known irradiation history. For this method of validation, the terms Δki, Δkx, and potentially parts of Δkc can be inseparable. The uncertainty in the **nuclide composition** and cross sections is captured in the calculation of the multiplication factor of the criticality experiment with irradiated fuel. **Another combined validation approach uses measured changes in reactivity with burnup. The measured change in reactivity with burnup may come from power reactor data or worth experiments that measure the change in reactivity from an initial unburned condition. In this approach Δki and Δkx of Eq. (1) are replaced by Δkd. The term Δkd is an allowance for the bias and uncertainty in bias of the change in k with irradiation. In this approach kc and Δkc are based on the fuel in the initial condition, and all the burnup-dependent uncertainties are included in Δkd. In the case of nuclides not contained in the Δkd data, Δki and Δkx may be used for these additional nuclides. Δkd shall account for any bias and uncertainty in that bias in converting the measured conditions to the conditions in the application.**						(+) CRIT FACILITIES	X	
18.06.916	ANS 8.27	5.3	5. Validation for burnup credit (Continued) 5.3 Analysis of trends The variations in Δki, Δkx, Δkb, and kc as a function of burnup and other relevant parameters shall be determined and documented.						(+) CRIT FACILITIES	X	
18.06.917	ANS 8.27	6	6. Burnup credit analysis Burnup credit analysis requires calculation of the nuclide compositions in a manner that appropriately covers the fuel to be loaded into the system to be analyzed. With the nuclide concentrations identified, the distribution of these nuclides in the analysis shall be consistent with the fuel to be loaded in the system. Finally, the constraints for loading the system shall be described. Secs 6.1, 6.2, and 6.3 cover these three topics.						(+) CRIT FACILITIES	X	

TABLE 1 - S/RID FUNCTIONAL AREA 18 (NUCLEAR AND PROCESS SAFETY) REQUIREMENTS

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18.06.918	ANS 8.27	6.1	6. Burnup credit analysis (Continued) 6.1 Calculation of the nuclide composition For those nuclides credited in the calculation of kp, their composition shall be determined by modeling the fuel with the irradiation and decay conditions experienced or postulated in the reactor. The analysis shall assess the range of conditions under which the fuel was or could be irradiated in order to provide justification for the values used in the analysis. Further, the analysis shall account for any changes in the nuclide composition over the range of cooling times allowed. At a minimum, the following reactor and fuel conditions shall be addressed in the analysis: (1) burnup; (2) reactivity control (e.g., soluble boron and/or control rods/blades); (3) presence of any burnable absorbers (fixed or removable); (4) coolant temperature and density; (5) fuel temperature; (6) power density; (7) cooling time. **ANSI/ANS-19.3-2011** Steady-State Neutron**ics Methods for Power Reactor Analysis** provides additional guidance on performing depletion calculations.						(+) CRIT FACILITIES	X	
18.06.919	ANS 8.27	6.2	6. Burnup credit analysis (Continued) 6.2 Calculation of the system kp The method of analysis used to determine kp shall be capable of modeling the material and geometric conditions for the systems of interest commensurate with the degree of conservatism and with the uncertainties assumed in the analysis. The spatial variation in the nuclide composition caused by both the axial and the horizontal nonuniform burnup in the reactor shall be included in the analysis of kp.						(+) CRIT FACILITIES	X	

TABLE 1 - S/RID FUNCTIONAL AREA 18 (NUCLEAR AND PROCESS SAFETY) REQUIREMENTS

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				Nuclear HC-1,2,3	Radi-ological	High Hazard Chemical	Low Hazard Chemical	Other Industrial	Facility Specific	Common	Facility Specific
18.06.920	ANS 8.27	6.3	6. Burnup credit analysis (Continued) 6.3. Generation of loading constraints Using the subcriticality criteria of Eq. (1), parameters or conditions shall be determined that establish acceptable loading constraints for placement of fuel assemblies into the system. For pressurized water reactor fuel, the primary loading constraint could be a required minimum burnup versus initial fuel enrichment with secondary constraints (e.g., number of burnable absorber rods, restriction on assembly type) utilized as needed. For BWR fuel, the loading constraints may utilize other parameters such as gadolinium content or the multiplication factor of an infinite array of assemblies in the storage rack or basket geometry. The **nuclear** criticality safety evaluation shall identify assumptions used to determine the loading constraints. The limiting assumptions consistent with the reactor and fuel conditions noted in Sec. 6.1 shall be justified. Note: Eq. (1) can be found in 18.06.901 and in ANS-8.27.						(+) CRIT FACILITIES	X	
18.06.921	ANS 8.27	7.1	7. Operational considerations 7.1 Administrative and operating procedures Administrative practices, controls, and written procedures that are consistent with the requirements of **ANSI/**ANS-8.1-**2014** and **ANSI/ANS-8.19-2014** "Administrative Practices for Nuclear Criticality Safety", shall be used to restrict loading only fuel that meets the loading constraints. Note:ANS-8.1-2014 is included in this Functional Area as Requirements 18.06.051 through 18.06.069 and ANS-8.19-2014 is included in this Functional Area as Requirements 18.06.501 through 18.06.546.						(+) CRIT FACILITIES	X	

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18.06.922	ANS 8.27	7.2	7. Operational considerations (Continued) 7.2 Burnup assignment With the exception of certain burnable absorber credit applications for which a burnup value is not needed (typically for BWR fuel, where the maximum reactivity composition has been used in the criticality safety evaluation), specification of an assigned fuel burnup is generally required for burnup credit applications. The assigned fuel burnup may be obtained from the records of the nuclear facility or by measurement after the assembly is discharged. This standard does not address how the burnup in the reactor records was obtained. The assigned burnup value or loading constraints shall be adjusted by the uncertainty associated with the assigned burnup to account for a potentially more reactive assembly. Alternatively, the reactivity effect of the burnup uncertainty (Δkb) shall be accounted for as shown in Eq. (1). **As noted earlier in this standard, the burnup uncertainty may be statistically combined with the other uncertainties in Eq. (1) with appropriate justification and consideration of correlations.** The burnup uncertainty in the reactor records may be established by a review of the uncertainties in the parameters and method used to determine the reactor records or by comparing the reactor record burnup values with measurements of burnup. Note: Eq. (1) can be found in 18.06.901 and in ANS-8.27.						(+) CRIT FACILITIES	X	
18.06.923	ANS 8.27	7.3	7. Operational considerations (Continued) 7.3 Independent verification Prior to placing a fuel assembly in a system to which burnup credit is applied, compliance with the loading constraints shall be independently verified. The independent verification shall be consistent with the criticality risk of the application or intended use.						(+) CRIT FACILITIES	X	