5. NUCLEAR CRITICALITY SAFETY

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5.1 ~~PURPOSE OF REVIEW~~Purpose of Review

The primary purpose of ~~this~~ the review is to determine ~~whether the applicant's nuclear~~with reasonable assurance that the applicant has designed a facility that will provide adequate protection against criticality ~~safety (NCS) program is adequate~~ hazards related to ~~support safe operation~~the storage, handling, and processing of ~~the facility,~~licensed materials as required by Title 10, Part 70, "Domestic Licensing of Special Nuclear Material," of the *Code of Federal Regulations* (10 CFR Part 70). The facility design must adequately protect the health and safety of workers and the public during normal operations and credible accident conditions from the accidental criticality risks in the facility. It must also protect against facility conditions that could affect the safety of licensed materials and thus present an increased criticality or radiation release risk.

~~10 CFR Part 70. The reviewers should examine the controls and barriers that are relied on to prevent inadvertent nuclear criticalities and that are designated as IROFS in the applicant's ISA Summary. The NCS review should be coordinated with the onsite ISA review (see Section 3.5.2.3 of this SRP) to examine the NCS evaluations used to prepare the facility's ISA.~~

~~**5.2 RESPONSIBILITY FOR REVIEW**~~

~~Another purpose of this review is to determine, with reasonable assurance, whether the licensee's or applicant's nuclear criticality safety (NCS) program as described in the license application and integrated safety analysis (ISA) summary is adequate to meet the regulatory requirements in Title 10, Part 70, "Domestic Licensing of Special Nuclear Material," of the *Code of Federal Regulations* (10 CFR Part 70) and will support safe possession and use of nuclear material at the facility. The review should examine the parts of the license application and ISA summary that describe the NCS program. The review should ensure that either the license application for a new facility or license amendment to an existing facility meets the regulatory requirements of 10 CFR Part 70 as described in this chapter. The review should also ensure that, if applicable, the criteria specified in 10 CFR Part 70 for meeting 10 CFR 70.61, "Performance Requirements," are satisfied and that the contents of the ISA summary required by 10 CFR 70.65, "Additional Content of Applications," meet the regulatory requirements for the NCS-related areas of the ISA summary.~~

5.2 Responsibility for Review

~~Primary~~: Nuclear Process Engineer (NCS Reviewer)

~~Secondary: None~~

~~*** Note: This is a proposed revision to Chapter 5 of NUREG-1520 ***~~

~~Supporting~~: Licensing Project Manager ~~and~~
Fuel Cycle ~~Inspector (As needed.)~~ Inspection Staff

~~**5.3 AREAS OF REVIEW**~~ Primary Reviewers for Chapters 1, 3, 8, and 11 of this Standard Review Plan (SRP)

5.3 Areas of Review

5.3.1 License Application

The staff should review the license application and ISA summary, if applicable, to determine whether ~~(1) the applicant has provided~~the application meets the 10 CFR Part 70 requirements for the ~~appropriate management of the~~ NCS ~~program; (2) the applicant has identified and committed to the responsibilities and authorities of individuals for developing and implementing the NCS program; (3) the facility management measures described in 10 CFR 70.62 have been committed to and will support implementing and maintaining the NCS program; and (4) an adequate NCS program is described that includes identifying and committing to the methodologies and technical practices used to ensure the safe operation of the facility, as required by 10 CFR Part 70.~~ related areas. The regulatory requirements for the license application review should comply with the general and additional content of an application, as required by 10 CFR 70.22, "Content of Applications," and 10 CFR 70.65, "Additional Content of Applications," respectively The NCS reviewer should review the application or amendment to determine whether the applicant has met the requirements of 10 CFR 70.23, "Requirements for the Approval of Applications," to ensure that the applicant has proposed equipment, facilities, and procedures to protect health and minimize danger to life or property, and 10 CFR 70.64, "Requirements for New Facilities or New Processes at Existing Facilities," as applicable, to ensure that the design provides for criticality control including adherence to the double contingency principle.

The ~~specific areas for review are as follows:~~

~~**5.3.1 Management of the** NCS **Program**~~

~~The primary~~ reviewer should review the ~~application to determine whether the applicant has~~ ISA related requirements in 10 CFR 70.62, "Safety Program and Integrated Safety Analysis," and 10 CFR 70.65, including the requirement for criticality monitoring and alarms. The regulation established in Title 10, Section 70.62(a), of the *Code of Federal Regulations* (10 CFR 70.62(a)) requires an applicant to develop, implement, and maintain a safety program that will reasonably protect the health and safety of the public and the environment from criticality hazards associated with processing, handling, and storing licensed materials during normal operations, anticipated operational occurrences, and credible accidents. For criticality safety the nuclear criticality safety program is the program used to address these process-specific risks, as well as other criticality related areas such as performing calculations, making criticality evaluations, or demonstration of subcritical margin. In addition, the NCS review should verify compliance with 10 CFR 70.61 for meeting the performance requirements and assuring that under normal and credible abnormal conditions that all nuclear processes are subcritical.

5.3.2 Nuclear Criticality Safety Program

The NCS reviewer should ensure that the applicant has committed to and implemented effective management of the NCS program in the license application and has provided enough qualified resources for an effective NCS program. The ~~objectives~~primary objective of an effective NCS program is to prevent an inadvertent nuclear criticality. Although 10 CFR Part 70, "Domestic Licensing of Special Nuclear Material," does not require a nuclear safety program directly, an

applicant should ~~include:~~ provide commitments pertaining to nuclear criticality safety in the following areas:

~~(a) preventing an inadvertent nuclear criticality~~

~~(b) protecting against the occurrence of an identified accident sequence in the ISA Summary that could lead to an inadvertent nuclear criticality~~

~~(c) complying with the NCS performance requirements of 10 CFR 70.61~~

- establishing and maintaining NCS safety parameters and procedures
- establishing and maintaining NCS safety limits and NCS operating limits for ~~IROFS~~controls
- conducting NCS evaluations to ~~assure~~ ensure that, under normal and credible abnormal conditions, all nuclear processes ~~are~~ remain subcritical ~~and maintain~~ with an approved margin of subcriticality for safety

~~(d) establishing and maintaining NCS IROFS, based on current NCS determinations~~

- providing training in ~~emergency~~ procedures ~~in~~ for criticality-related possession and use of nuclear material and for response to an inadvertent nuclear criticality
- complying with NCS baseline design criteria requirements in ~~10 CFR~~ 10 CFR 70.64(a) if the application is for a new facility or for a new process at an existing facility

~~(e) complying with the NCS ISA Summary requirements in 10 CFR 70.65(b)~~

~~(f)~~ complying with the NCS ISA ~~Summary~~summary change process requirements ~~in 10 CFR~~ of 10 CFR 70.72

- ~~**5.3.2 ISA Organization**~~, "Facility Changes and ~~**Administration**~~ Change Process"
- protecting against the occurrence of an identified accident sequence in the ISA summary that could lead to an inadvertent nuclear criticality
- complying with the NCS performance requirements of 10 CFR 70.61

The reviewer~~(s)~~ should determine whether the applicant has identified ~~and committed to the~~ responsibilities and authorities of individuals to ~~develop, organize,~~ implement and administer the NCS program. The following matters related to the applicant's organization and administration should be reviewed:
~~for familiarity,~~

- the general organization and administration methods used by the applicant (see SRP ~~Chapter~~ Chapter 2)

- the areas of review listed in SRP ~~Section~~ Section 2.3 as they relate to NCS, including the experience, educational requirements, responsibilities, and authorities of NCS management and staff

~~5.3.3 Management Measures~~ 5.3.3 Safety Program

The reviewer~~(s)~~ should determine whether the applicant has committed to the facility safety program including the process safety information, ISA, and management measures in ~~10 CFR~~ 10 CFR 70.62 and whether the commitments demonstrate the applicant's ability to implement and maintain the NCS ~~program.~~controls. The NCS review should cover the following specifications:

- process descriptions—narrative description of the site, facility, and processes with respect to criticality safety for normal operations. The criticality process description can include flow diagrams, major process steps, and major pieces of equipment with emphasis on the criticality safety controls. The ISA summary must include a reasonably simple description of each process (unit operations).
- criticality accident sequences—including unmitigated accident sequences involving licensed materials and interpretation of the sequence of events as described in the ISA summary.
- criticality accident consequences—identified in the ISA summary, including the assumption that all criticality accidents are high consequence and that the bases and methods the applicant used are based on using preventative controls.
- criticality process IROFS and sole IROFS—including a list of items relied on for criticality safety and a description of their safety function as described in the ISA summary.
- criticality IROFS management measures—including management measures to ensure the reliability and availability of the IROFS described in the ISA summary.

The following matters related to the applicant's ~~management measures should~~ ability to implement and maintain controls to assure availability and reliability should also be reviewed ~~in the application~~:

~~For familiarity,~~

- the ~~general~~ configuration management, maintenance, training and qualifications, procedures, audits and assessments, incident investigations, records management, and other quality assurance elements used by the applicant (see SRP ~~Sections~~ Sections 11.3.1 through 11.3.8)~~; and~~
- ~~Management~~management provisions for the following:
  - training and qualifications of NCS management and staff

– auditing, assessing, and upgrading the NCS program

~~(a) revising the ISA Summary as it relates to NCS~~

~~(b) recommending modifications to operating and maintenance procedures, to reduce the likelihood of occurrence of an inadvertent nuclear criticality~~

~~designing and~~

– maintaining current NCS safety basis documentation

– installing and maintaining a criticality accident alarm system (CAAS) to ~~provide immediate detection~~detect and ~~annunciation of~~annunciate an inadvertent nuclear criticality

– referring NCS deficiencies to the corrective action ~~function any unacceptable performance deficiencies that might result in an inadvertent nuclear criticality~~ program

~~(c) referring to the corrective action function any unacceptable performance deficiencies that did result in an inadvertent nuclear criticality~~

– retaining records of the NCS program, including independent reviews, audits, and documentation of corrective actions taken

~~**5.3.4 Methodologies and Technical Practices**~~

~~The reviewer(s) should determine whether the applicant has identified NCS methodologies and NCS technical practices used to make NCS determinations, as required by 10 CFR 70.24, "Criticality Accident Requirements" (for criticality accident alarm systems), 10 CFR 70.61(d), "Performance Requirements" (which require that under normal and credible abnormal conditions, all nuclear processes remain subcritical, and maintain an approved margin of subcriticality for safety), 10 CFR 70.64(a), "Requirements for New Facilities or New Processes at Existing Facilities" (baseline design criteria), and 10 CFR 70.65(b), "Additional Content of Applications", (the ISA Summary). The following matters related to the applicant's NCS methodologies and NCS technical practices should be reviewed in the application:~~

~~(1) the commitment to use the NCS methodologies identified in the applicant's NCS program~~

~~(1) the commitment to use the NCS technical practices identified in the applicant's NCS program~~

~~(2)~~ ~~(2) the commitment to fulfill the requirements of 10 CFR 70.24 and to have a CAAS that has been incorporated into the facility management measures~~

~~(3) the commitment to detect an inadvertent nuclear criticality and promptly notify personnel, which should ensure that the radiation exposure to workers will be minimized~~

~~(4) the commitment to the requirements of 10 CFR 70.61(d)~~

~~(5) the commitment to the requirements in 10 CFR 70.64 as they relate to NCS~~

~~(6) the areas of review listed in SRP Section 3.3 as they relate to NCS, including accident sequences, consequences, likelihoods and IROFS~~

~~(7) identification and use of appropriate NCS methodologies and NCS technical practices~~

~~**5.4 ACCEPTANCE CRITERIA**~~

Review Interfaces

In addition to Chapter 5 of the license application, the criticality safety reviewer should examine information in the following other areas to ensure that it is consistent with the information in Chapter 5 of the application:

- facility and process description applied to chemical safety as described in Chapter 1 of this Standard Review Plan (SRP).
- administration and organization of the criticality safety functions as described in Chapter 2 of this Standard Review Plan (SRP).
- safety program, ISA commitments, and ISA documentation applied to criticality safety under SRP Chapter 3.
- emergency plan applied to criticality safety under SRP Chapter 8.
- configuration management, maintenance, training and qualifications, procedures, audits and assessments, incident investigations, record management, and other quality assurance elements as described in (SRP) Chapter 11.

5.4 Acceptance Criteria

The applicant should provide NCS commitments and describe how the commitments will be met. Commitments and descriptions are expected ~~only~~ when the acceptance criteria are relevant to the ~~operations and~~ possession and use of nuclear materials and the materials to be licensed.

~~The applicant's use of standards should be considered acceptable if the applicant has met the following acceptance criteria:~~

~~If an applicant intends to conduct activities to which a standard applies and the standard has been endorsed by an NRC~~**5.4.1 Regulatory** ~~Guide, then a commitment to comply with all the requirements (i.e., "shalls") of the standard is necessary but may not be sufficient to meet the acceptance criteria. Notwithstanding a general commitment to a standard, the applicant should clarify its intended compliance with those requirements in the standard that are expressed only as general principles by more specific commitments and descriptions in the application. Any~~

variations from the requirements of the standard should be identified and justified in the application. The commitments and descriptions should be considered acceptable if the applicant has met the acceptance criteria described below.

Requirements

5.4.1 Regulatory Requirements

The regulatory basis for the review should be the general and "additional content" of an application, as required by 10 CFR 70.22 and 70.65, respectively. In addition, the NCS review should verify compliance with 10 CFR 70.24, 70.61, 70.62, 70.64, 70.72, and Appendix A of 10 CFR Part 70.

5.4.2 Regulatory Guidance

NRC Regulatory Guide 3.71, "Nuclear Criticality Safety Standards for Fuels and Materials Facilities," August 1998, endorses the American National Standards Institute (ANSI)/American Nuclear Society (ANS)-8 national standards listed below in part or in full.

- ANSI/ANS-8.1, "Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors," 1983 (Reaffirmed in 1988).
- ANSI/ANS-8.3, "Criticality Accident Alarm System," 1997.
- ANSI/ANS-8.5, "Use of Borosilicate-Glass Raschig Rings as a Neutron Absorber in Solutions of Fissile Material," 1996.
- ANSI/ANS-8.6, "Safety in Conducting Subcritical Neutron-Multiplication Measurements In Situ," 1983 (Reaffirmed in 1995).
- ANSI/ANS-8.7, "Guide for Nuclear Criticality Safety in the Storage of Fissile Materials," 1975 (Reaffirmed in 1987).
- ANSI/ANS-8.9, "Nuclear Criticality Safety Criteria for Steel Pipe Intersections Containing Aqueous Solutions of Fissile Materials," 1987 (Reaffirmed in 1995).
- ANSI/ANS-8.10, "Criteria for Nuclear Criticality Safety Controls in Operations With Shielding and Confinement," 1983 (Reaffirmed in 1988).
- ANSI/ANS-8.12, "Nuclear Criticality Control and Safety of Plutonium-Uranium Fuel Mixtures Outside Reactors," 1987 (Reaffirmed in 1993).
- ANSI/ANS-8.15, "Nuclear Criticality Control of Special Actinide Elements," 1981 (Reaffirmed in 1995).
- ANSI/ANS-8.17, "Criticality Safety Criteria for the Handling, Storage, and Transportation of LWR Fuel Outside Reactors," 1984 (Reaffirmed in 1997).
- ANSI/ANS-8.19, "Administrative Practices for Nuclear Criticality Safety," 1996.

• ANSI/ANS-8.20, "Nuclear Criticality Safety Training," 1991.

• ANSI/ANS-8.21, "Use of Fixed Neutron Absorbers in Nuclear Facilities Outside Reactors," 1995.

• ANSI/ANS-8.22, "Nuclear Criticality Safety Based on Limiting and Controlling Moderators," 1997.

• ANSI/ANS-8.23, "Nuclear Criticality Accident Emergency Planning and Response," 1997.

NRC endorsement of these standards means that they provide procedures and methodology generally acceptable to NRC staff for the prevention and mitigation of nuclear criticality accidents. However, application of a standard is not a substitute for detailed nuclear criticality safety analyses for specific operations. Applicants should generally use the most current revision of the aforementioned standards. If an applicant commits to an unendorsed standard, then the applicant needs to demonstrate in the application why the unendorsed standard should be acceptable to NRC.

5.4.3 Regulatory Acceptance **Criteria**

5.4.3.1 Management of the NCS Program

The applicant's management of the NCS program should be considered acceptable if the applicant has met the following acceptance criteria or has identified and justified an alternative in the application:

The applicant commits to develop, implement, and maintain an NCS program to meet the regulatoryare based on meeting the relevant requirements of 10 CFR Part 70.the following regulations:

- The applicant states the NCS program objectives, which should include those objectives listed in SRP Section 5.3.1.The general and additional contents of an application for criticality safety are given in 10 CFR 70.22, "Contents of Applications," and 10 CFR 70.65, respectively. General information that must be included in the license application appears in 10 CFR 70.22. Information that must be included in the ISA summary, including the requirements for criticality monitoring and alarms, appears in 10 CFR 70.65.

- The applicant establishes NCS safety parameters and procedures.The requirements for the approval of the application are in 10 CFR 70.23.

(1) The applicant outlines an NCS program structure and defines the responsibilities and authorities of key program personnel.

(2) The applicant commits to keep NCS methodologies and NCS technical practices applicable to current configuration by means of the configuration management function.

(3) The applicant commits to use the NCS program to establish and maintain NCS safety limits and NCS operating limits for IROFS in nuclear processes and commits to maintain adequate management measures to ensure the availability and reliability of the IROFS.

(4) The applicant commits to preparation of NCS postings, to NCS training, and to NCS emergency procedure training.

(5) The applicant commits to adhere to the NCS baseline design criteria requirements in 10 CFR 70.64(a) Requirements for new facilities and or new processes at existing facilities that require a license amendment under 10 CFR 70.72.

(6) The applicant commits to use the NCS program to evaluate modifications to operations, to recommend process parameter changes necessary to maintain the safe operation of the facility, and to select appropriate IROFS and management measures.

5.4.3.2 Organization and Administration

Information related to NCS organization and administration acceptance criteria may be located in the organization and administration part of the application (SRP Chapter 2). The applicant's NCS organization and administration should be considered acceptable if the applicant has met the following acceptance criteria or has identified and justified an alternative in the application:

(1) The applicant meets the acceptance criteria in SRP Section 2.4 as they relate to NCS, "Facility Changes and Change Process," appear in 10 CFR Part 70.64, including organizational positions, functional responsibilities, experience, and qualifications of personnel responsible for NCS.

(2) The applicant commits to ANSI/ANS 8.1 1983 and ANSI/ANS 8.19 1996, as they relate to organization and administration.

(3) The applicant commits to the intent of Section 4.11 of ANSI/ANS 8.1 1983, which is to use personnel, skilled in the interpretation of data pertinent to NCS and familiar with the operation of the facility, as a resource in NCS management decisions. These specialists should be independent of operations supervision.

(4) The applicant commits to provide NCS postings in areas, operations, work stations, and storage locations.

(5) The applicant commits to the following policy: Personnel shall report defective NCS conditions to the NCS function and perform actions only in accordance with written, approved procedures. Unless a specific procedure deals with the situation, personnel shall report defective NCS conditions to the NCS function and take no action until the NCS function has evaluated the situation and provided recovery procedures.

(6) The applicant commits to describe organizational positions, experience of personnel, qualifications of personnel, and functional responsibilities, and commits also to outline organizational relations among the individual positions.

(7) The applicant commits to designate an NCS program director who will be responsible for implementation of the NCS program.

(8) The applicant commits to staff the NCS program with suitably trained personnel and to provide sufficient resources for its operation.

5.4.3.3 Management Measures

Information related to NCS management measures acceptance criteria may be located in the management measures part of the application. The applicant's NCS management measures (required by 10 CFR 70.62) should be considered acceptable if the applicant has met the following acceptance criteria or has identified and justified an alternative in the application:

(1) Training (see SRP Section 11.4.3.3)

(a) The applicant commits to ANSI/ANS-8.19-1996 and ANSI/ANS-8.20-1991 as they relate to training.

(b) The applicant commits to provide training to all personnel to recognize the CAAS signal and to evacuate promptly to a safe area.

(c) The applicant commits to provide instruction training regarding the policy in SRP Section 5.4.3.2(5).

(2) Procedures (see SRP Section 11.4.3.4)

(a) The applicant commits to ANSI/ANS-8.19-1996 as it relates to procedures and to the policy that no single, inadvertent departure from a procedure could cause an inadvertent nuclear criticality.

(3) Audits and assessments (see SRP Section 11.4.3.5)

(a) The applicant commits to ANSI/ANS-8.19-1996 as it relates to audits and assessments.

(b) The applicant commits to conduct and document weekly NCS walkthroughs (e.g., using checklists) of all operating SNM process areas such that all operating SNM process areas will be reviewed at least every 2 weeks. Identified weaknesses should be referred to the facility corrective action function and should be promptly and effectively resolved. A graded approach may be used to justify an alternate NCS walkthrough schedule if it is based on the ISA and included in the ISA Summary.

(c) The applicant commits to conduct and document quarterly NCS audits such that all NCS aspects of management measures (see SRP Chapter 11) will be audited at least every 2 years. A graded approach may be used to justify an alternate NCS audit schedule if it is based on the ISA and included in the ISA Summary.

~~**5.4.3.4 Methodologies and Technical Practices**~~

~~The applicant's methodologies and technical practices should be considered acceptable if the applicant has met the following acceptance criteria or has identified and justified an alternative in the application:~~

~~(1) NCS controlled parameters will be appropriately applied.~~

~~(2) NCS limits on IROFS will be appropriately determined.~~

~~**5.4.3.4.1 Methodologies**~~

~~The applicant's commitment to NCS methodologies should be considered acceptable if the applicant has met the following acceptance criteria or has identified and justified an alternative in the application:~~

~~(1) NCS determinations will be performed using acceptable methodologies.~~

~~(2) NCS limits on controls and controlled parameters will be established to ensure an adequate margin of subcriticality for safety.~~

~~(3) Methods used to develop NCS limits will be validated to ensure that they are within acceptable ranges, and that the applicant utilized both appropriate assumptions, and acceptable computer codes.~~

~~(4) An inadvertent nuclear criticality will be detected promptly to ensure that radiation exposures to workers are minimized.~~

~~(5) The applicant commits to ANSI/ANS-8.1-1983 as it relates to methodologies.~~

~~(6) The applicant commits to the *intent* of the validation report statement in NRC Regulatory Guide 3.71, August 1998, which states that the applicant should demonstrate: (1) the adequacy of the margin of safety for subcriticality by assuring that the margin is large compared to the uncertainty in the calculated value of k-eff, (2) that the calculation of k-eff is based on a set of variables whose values lie in a range for which the methodology used to determine k-eff has been validated, and (3) that trends in the bias support the extension of the methodology to areas outside the area or areas of applicability.~~

~~(7) The applicant includes a reference to (including the date and revision number), and summary description of, either a manual or a documented, reviewed, and approved validation report (by NCS function and management) for each methodology that will be used to make an NCS determination (e.g., experimental data, reference books, hand calculations, deterministic computer codes, probabilistic computer codes, consensus standards). When there are changes to either a reference manual or validation report, the change should be reported to NRC by letter. After reviewing the change notification letter, NRC will determine if a review of a reference manual or validation report is necessary. The summary description of a reference manual or validation report should have:~~

(a) A summary of the theory of the methodology that is sufficiently detailed and clear to allow understanding of the methodology.

(b) A summary of the area or areas to which the reference manual or validation report applies.

(c) A commitment to apply the methodology only in the area or areas of applicability or provide justifications for applying the methodology outside the area or areas of applicability.

(d) A commitment to use pertinent computer codes, assumptions, and techniques in the methodology.

(e) A commitment to properly perform the mathematical operations in the methodology.

(f) A commitment to use data based upon reliable and reproducible experimental measurements.

(g) A commitment to use plant-specific benchmark experiments and data derived therefrom to validate the methodology.

(h) A commitment to determine the bias, the uncertainty in the bias, the uncertainty in the methodology, the uncertainty in the data, the uncertainty in the benchmark experiments, and the margin of subcriticality for safety, when using the methodology.

(i) A commitment to use controlled software and hardware, when using the methodology.

(j) A commitment to use a verification process when using the methodology.

(8) The applicant commits to have, at the facility, the reference manual or documented, reviewed, and approved validation report (by NCS function and management) for each methodology used to make an NCS determination. The manual or validation report should have:

(a) A description of the theory of the methodology that is sufficiently detailed and clear to allow understanding of the methodology and independent duplication of results.

(b) A description of the area or areas of applicability that identifies the range of values for which valid results have been obtained for the parameters used in the methodology. In accordance with the provisions in ANSI/ANS-8.1-1983, any extrapolation beyond the area or areas of applicability should be supported by an established mathematical methodology.

(c) A description of the use of pertinent computer codes, assumptions, and techniques in the methodology.

(d) A description of the proper functioning of the mathematical operations in the methodology (e.g., a description of mathematical testing).

(e) A description of the data used in the methodology, showing that the data were based on reliable experimental measurements.

(f) A description of the plant specific benchmark experiments and the data derived therefrom that were used for validating the methodology.

(g) A description of the bias, uncertainty in the bias, uncertainty in the methodology, uncertainty in the data, uncertainty in the benchmark experiments, and margin of subcriticality for safety, as well as the basis for these items, as they are used in the methodology. If the bias is determined to be advantageous to the applicant, the applicant shall use a bias of 0.0 (e.g., in a critical experiment where the k-eff is known to be 1.00 and the code calculates 1.02, the applicant cannot use a bias of 0.02 to allow calculations to be made above the value of 1.00).

(h) A description of the software and hardware that will use the methodology.

(i) A description of the verification process and results.

(9) The applicant commits to incorporate each reference manual or documented, reviewed, and approved validation report (by NCS function and management) for a methodology, as well as the assumptions used, into the facility configuration management program.

(10) The applicant commits to performing NCS determinations in accordance with specified methods incorporated in the facility's management measures and in accordance with the following principles.

(a) NCS safety limits, NCS operating limits, and limits on NCS controlled parameters will be established assuming credible optimum conditions (i.e., most reactive conditions physically possible or limited by written commitments to regulatory agencies) unless specified controls are implemented to control the limit to a certain range of values.

(b) NCS safety limits, NCS operating limits, and limits on NCS controlled parameters will be derived from the NCS determinations.

(c) NCS safety limits, NCS operating limits, and limits on NCS controlled parameters will be based on the proper application of the NCS methodology to the process under study.

(d) NCS operating limits will be derived from NCS safety limits by taking into consideration changes in operating parameters to ensure processes will remain subcritical under both normal and credible abnormal conditions.

(e) NCS operating limits will establish sufficient margins of safety for processes and take into consideration the variability and uncertainty in processes and the NCS subcritical limits.

(f) NCS safety limits will establish sufficient margins of safety for processes and take into consideration the variability and uncertainty in processes and the NCS operating limits.

(g) The margin of subcriticality for safety for a process should be relative compared to the calculated value of k-eff.

(h) K-eff is calculated from a set of variables whose values lie in a range for which the validity of the NCS methodology has been demonstrated.

5.4.3.4.2 Technical Practices

Controlled parameters available for NCS control include the following: mass, geometry, density, enrichment, reflection, moderation, concentration, interaction, neutron absorption, and volume. The applicant's commitment to NCS technical practices should be considered acceptable if the applicant has met the following acceptance criteria or has identified and justified an alternative in the application:

- The applicant's use of a single NCS control to maintain the values of two or more controlled parameters constitutes only one component necessary to meet the requirement to adhere to the double contingency protection principle.

- Based on 10 CFR 70.61, the applicant commits to the policy that no single credible event or failure can result in a criticality accident. Requirements to maintain and establish a safety program are found in 10 CFR 70.62, "Safety Program and Integrated Safety Analysis."

- The applicant commits to the preferred use of passive engineered controls to ensure NCS. In general, the applicant should commit to the following order of preference, for NCS controls: (a) passive engineered; (b) active engineered; (c) augmented administrative; and (d) simple administrative. When using a control, the choice of the type and manner should be justified. The criticality safety review should be conducted to provide reasonable assurance of compliance with the performance requirements in 10 CFR 70.61.

When evaluating a controlled parameter, the applicant should consider heterogeneous effects. Heterogeneous effects are particularly relevant for low-enriched uranium processes, where, all other parameters being equal, heterogeneous systems are more reactive than homogeneous systems.

(1) The applicant commits to perform an evaluation for all controlled parameters that shows that during both normal and credible abnormal conditions, the controlled parameter will be maintained.

(2) When controlled parameters are controlled by measurement, reliable methods and instruments should be used. Where there is significant susceptibility to human error, the applicant may commit to representative sampling, reliable measurement instruments and methods, and dual independent measurements.

(3) The use of mass as a controlled parameter should be considered acceptable if:

(a) When a given mass of material has been determined, a percentage factor is used to determine the mass percentage of SNM in that material.

(b) When fixed geometric devices are used to limit the mass of SNM, a conservative process density is used.

(c) When the mass is measured, instrumentation is used.

(d) When using double-batching of SNM as a single parameter limit control from experimental data, and double batching of SNM is possible, the mass of SNM is limited to no more than 45 percent of the minimum critical mass, based on spherical geometry.

(e) When using double batching of SNM as a single parameter limit control from experimental data and double batching of SNM is not possible, the mass of SNM is limited to no more than 75 percent of the critical mass, based on spherical geometry.

(8) The use of geometry as a controlled parameter should be considered acceptable if:

(a) Before beginning operations, all dimensions and nuclear properties that use geometry control are verified. The facility configuration management program should be used to maintain these dimensions and nuclear properties.

(b) When using large single units as a single parameter control from experimental data, the margins of safety are 90 percent of the minimum critical cylinder diameter, 85 percent of the minimum critical slab thickness, and 75 percent of the minimum critical sphere volume.

(9) The use of density as a controlled parameter should be considered acceptable if:

(a) When process variables can affect the density, the process variables are shown in the ISA Summary to be controlled by IROFS.

(b) When the density is measured, the measurement is obtained by the use of instrumentation.

(10) The use of enrichment as a controlled parameter should be considered acceptable if:

(a) A method of segregating enrichments is used to ensure differing enrichments will not be interchanged, or else the most limiting enrichment is applied to all material.

(b) When the enrichment needs to be measured, the measurement is obtained by using instrumentation.

(11) The use of reflection as a controlled parameter should be considered acceptable if:

(a.) When investigating an individual unit, the wall thickness of the unit and all reflecting adjacent materials of the unit are considered. The adjacent materials should be farther than 30.48 cm (12 inches) away from the unit.

(b.) After identifying potential reflectors, the controls to prevent the presence of the potential reflectors are identified as IROFS in the ISA Summary.

(12) The use of moderation (e.g., exclusion of moderators) as a controlled parameter should be considered acceptable if:

(a) When using moderation, the applicant commits to ANSI/ANS 8.22-1997.

(b) When process variables can affect the moderation, the process variables are shown in the ISA Summary to be controlled by IROFS.

(c) When the moderation is measured, the measurement is obtained by using instrumentation.

(d) When designing physical structures, the design precludes the ingress of moderation.

(e) When moderation is needed to be sampled, dual independent sampling methods are used.

(f) When developing firefighting procedures for use in a moderation controlled area, restrictions are placed on the use of moderator material.

(g) After evaluating all credible sources of moderation for the potential for intrusion into a moderation controlled area, the ingress of moderation is precluded or controlled.

(13) The use of concentration as a controlled parameter should be considered acceptable if:

(a) When process variables can affect the concentration, the process variables are shown in the ISA Summary to be controlled by IROFS.

(b) High concentrations of SNM in a process are precluded unless the process is analyzed to be safe at any credible concentration.

(c) When using a tank containing concentration controlled solution, the tank is normally closed.

(d) When concentration needs to be sampled, dual independent sampling methods are used.

(e) After identifying possible precipitating agents, precautions are taken to ensure that such agents will not be inadvertently introduced.

(14) The use of interaction as a controlled parameter should be considered acceptable if:

(a) When maintaining a physical separation between units, engineered controls to ensure a minimum spacing or augmented administrative controls are used. The structural

~~integrity of the spacers or racks should be sufficient for normal and credible abnormal conditions.~~

~~(15) The use of neutron absorption as a controlled parameter should be considered acceptable if:~~

~~(a) When using borosilicate glass raschig rings, the applicant commits to ANSI/ANS-8.5-1996.~~

~~(b) When using fixed neutron absorbers, the applicant commits to ANSI/ANS-8.21-1995.~~

~~(c) When evaluating absorber effectiveness, neutron spectra are considered (e.g., cadmium is an effective absorber for thermal neutrons, but ineffective for fast neutrons).~~

~~(16) The use of volume as a controlled parameter should be considered acceptable if:~~

~~(a) When using volume control, fixed geometry is used to restrict the volume of SNM with engineered devices to limit the accumulation of SNM.~~

~~(b) When the volume is measured, instrumentation is used.~~

~~**5.4.3.4.3 Requirements in 10 CFR 70.24**~~

~~The applicant's~~**5.4.2 Regulatory Guidance**

The following additional guidance may be used to supplement the review of the NCS program:

- NUREG-1513, "Integrated Safety Analysis Guidance Document," May 2001.
- NUREG/CR-6410, "Nuclear Fuel Cycle Facility Accident Analysis Handbook," March 1998.

5.4.3 Regulatory Acceptance Criteria

The reviewer should find the applicant's criticality safety program information acceptable if it provides reasonable assurance that the acceptance criteria discussed below are adequately addressed and satisfied. The applicant may elect to incorporate some or all of the requested criticality safety information in the facility and process description (SRP Section 1.1) or in the ISA summary, rather than in this section. Either approach is acceptable, as long as the information is adequately cross-referenced.

5.4.3.1 License Application

The reviewer should consider the applicant's commitment to the CAAS requirements in 10 CFR 70.24 ~~should be considered~~ acceptable if the ~~applicant~~applicant or licensee has met the following acceptance criteria or has identified and justified an alternative in the application:

- The applicant ~~documents that the~~describes a facility CAAS that meets the requirements of 10 ~~CFR~~ CFR 70.24.

- The applicant commits to ANSI/ANS-8.3-1997, as modified by Regulatory ~~Guide~~ Guide 3.71~~, August 1998.~~. Regulatory Guide 3.71 lists the following exceptions to the standard:

  – At or above the ~~10 CFR~~ 10 CFR 70.24 mass limits, CAAS coverage should be required in each area ~~in which~~ where SNM is handled, stored, or used.

  – A requirement of ~~10 CFR~~ 10 CFR 70.24 is that two detectors cover each area ~~that needs~~needing CAAS coverage ~~be covered by two detectors~~.

  – A requirement of ~~10 CFR~~ 10 CFR 70.24 is that a CAAS be capable of detecting a nuclear criticality that produces an absorbed dose in soft tissue of ~~20~~ 20 rads of combined neutron and gamma radiation at an unshielded distance of ~~2~~ 2 meters from the reacting material within ~~1~~ 1 minute.

- The applicant commits to having a CAAS that is ~~uniform throughout the~~ appropriate for the facility for the type of radiation detected, ~~the mode of detection, the alarm signal~~intervening shielding, and the ~~system dependability.~~magnitude of the minimum accident of concern.

- The applicant commits to having a CAAS that is designed to remain operational during credible events such as a seismic shock equivalent to the site-specific, design-basis earthquake or the equivalent value specified by the Uniform Building Code.

- The applicant commits to having a CAAS that is designed to remain operational during credible events such as a fire, an explosion, a corrosive atmosphere, and other credible conditions.

- The applicant commits to having a CAAS alarm that is clearly audible in areas that must be evacuated or provides alternate notification methods that are documented to be effective in notifying personnel that evacuation is necessary.

- The applicant commits to rendering operations safe, by shutdown and quarantine if necessary, in any area where CAAS coverage has been lost and not restored within a specified number of hours. The number of hours should be determined on a process-by-process basis, because shutting down certain processes, even to make them safe, may carry a larger risk than being without a CAAS for a short time. The applicant should commit to compensatory measures (e.g., ~~limit~~limiting access, ~~halt~~halting SNM movement) when the CAAS system is not functional.

- ~~Emergency~~ The applicant commits to the following emergency management provisions (see SRP ~~Chapter~~ Chapter 8~~)~~):

- The applicant commits to the requirements in ANSI/ANS-8.23-1997 as they relate to NCS~~;~~.

- The applicant either has an emergency plan or satisfies the alternate requirements in ~~10 CFR~~ 10 CFR 70.22.(h)(1)(i).

- The applicant commits to ~~provide~~ the provision of fixed and personnel accident dosimeters in areas that require a CAAS. These dosimeters should be readily available to personnel responding to an emergency, and there should be a method for prompt onsite dosimeter readouts.

- The applicant commits to ~~provide~~ providing emergency power for the CAAS or ~~provide~~ provides justification for the use of continuous monitoring with portable instruments.

~~**5.4.3.4.4 Requirements in 10 CFR 70.61(d)**~~

~~The applicant's commitment to the requirements in 10 CFR 70.61(d) that under normal and credible abnormal conditions, all nuclear processes are subcritical, including use of an approved margin~~Using the reasonable assurance of ~~subcriticality for~~ safety ~~should be considered acceptable if the~~ standard as described in the introduction to this SRP, the reviewer should determine whether the applicant has met the ~~following acceptance criteria or has identified and justified an alternative in the application:~~

~~The applicant commits to the use~~ requirements of ~~NCS controls and controlled parameters to assure that under normal and credible abnormal conditions, all nuclear processes are subcritical, including use of an approved margin of subcriticality for safety.~~ 10 CFR 70.61. The introduction, as well as Section 3.1 of the SRP describing the review of the ISA and ISA summary, includes guidance on the level of detail needed to achieve this standard. The reviewer should consider the applicant's commitments to demonstrating that all nuclear processes will be subcritical under normal and credible abnormal conditions to be acceptable if the application includes the following acceptance criteria or identifies and justifies an alternative:

~~As stated in ANSI/ANS-8.1-1983~~

~~(1) As one approach,~~ the applicant commits to the following ~~policy: Process specifications shall incorporate margins to protect against uncertainties in process variables and against a limit being accidentally exceeded.~~

- ~~The applicant commits to the following~~ national standards, as they relate to these requirements: ANSI/ANS-8.7-1975, ANSI/ANS-8.9-1987, ANSI/ANS-8.10-1983, ANSI/ANS-8.12-1987, ANSI/ANS-8.15-1981, and ANSI/ANS-8.17-1984. Alternatively, the applicant commits to base the safety limits on validated calculational methods.

~~(2) If the applicant intends to use administrative k-eff margins for normal and credible abnormal conditions, the applicant commits to NRC pre-approval of the administrative margins.~~

~~(3) The applicant commits to determining subcritical limits for k-eff calculations such that: k-subcritical = 1.0 - bias margin, where the margin includes adequate allowance for uncertainty in the methodology, data, and bias to assure subcriticality.~~

~~(4) The applicant commits to performing studies to correlate the change in~~ describes a ~~value of a controlled parameter and its k-eff value. The studies should also include changing the value of one controlled parameter and determining its effect on another controlled parameter and k-eff.~~

~~(5) The applicant commits to implement an NCS~~ program that ensures compliance with the double ~~-~~contingency ~~protection, when~~ principle, where practicable~~. When evaluating~~ (see Appendix A for detailed guidance regarding the double contingency ~~protection, the following should be considered with respect to the contents of both ANSI/ANS-8.1-1983 and the likelihood discussion in SRP Chapter 3:~~

~~(a) Adherence to~~ principle). Processes in which there are no credible accident sequences that lead to criticality meet the double ~~-~~contingency ~~protection:~~principle by definition. This principle, as given in ANSI/ANS-8.1-1998, states that at least two changes in process conditions must occur before criticality is possible. If there are no process changes leading to criticality, then the principle is satisfied. Each process that has accident sequences ~~that could result in an inadvertent nuclear~~ leading to criticality should have sufficient controls in place to ensure double ~~-~~contingency protection. ~~Double contingency protection~~ This may be provided by either~~:~~

- ~~(i) at least two-parameter~~ (1) control ~~(the~~ ~~control~~ of ~~at least~~ two independent process parameters~~)~~ or (~~ii)~~ 2) control of a single ~~parameter control (a system of multiple independent controls on a single process parameter).~~ process parameter, such that at least two independent failures would have to occur before criticality is possible. The first method is ~~the preferred approach~~preferable because of the inherent difficulty ~~of~~ in preventing common-mode failure when controlling only one parameter.

~~As used in~~ The reviewer should note that the double ~~-~~contingency ~~protection~~principle requires two unlikely, independent, and concurrent changes in process conditions before criticality is possible. This does not necessarily mean that two controls are required. In some cases, it may be appropriate to credit the natural and credible course of events (e.g., unsintered powder cannot exceed a maximum density, there is no means of enriching beyond 5 wt% ^{235}U, the low historical likelihood of flooding) without establishing explicit controls. The reviewer should exercise judgment in determining whether the applicant has established sufficient means to ensure that occurrence of the contingencies is "unlikely." In addition, the term "concurrent" means that the effect of the first process change persists until a second change occurs~~, at which point the process could have an inadvertent nuclear criticality~~. It does not mean that the two events ~~initiating the change~~ must occur simultaneously. The possibility of an inadvertent ~~nuclear~~ criticality can be markedly reduced if failures of NCS controls are rapidly detected and the ~~processes~~ process rendered safe. If not, processes can remain vulnerable to a second failure for extended periods of time.

~~Exceptions to~~In a very few processes, double ~~contingency protection: There may be processes where double~~ ~~-~~contingency protection is not practicable. In those ~~processes,~~

~~the facility should implement sufficient redundancy and diversity in controlled parameters such that at least two unlikely and concurrent events, errors, accidents, or equipment malfunctions are necessary before an inadvertent nuclear criticality is possible. The applicant should commit in the license application, to identify in the ISA Summary any process that could lead to an inadvertent nuclear criticality and for which double contingency was not applied. The~~ rare instances, the applicant must provide adequate justification for ~~this decision in the ISA Summary~~why such cases are acceptable. The justification should demonstrate that there is sufficiently low risk that an exception is warranted. The reviewer should note that the double-contingency principle, as stated in ANSI/ANS-8.1-1998, is a recommendation ("Process designs should, in general, incorporate sufficient factors of safety…"). The more important requirement is the one incorporated in 10 CFR 70.61(d) ("it shall be determined that the entire process will be subcritical under both normal and credible abnormal conditions"). Thus, as long as the applicant can meet the underlying requirement to be subcritical under normal and credible abnormal conditions through other means, an exception may be justifiable.

~~(8)~~

- The applicant meets the acceptance criteria in SRP ~~Section 3.4,~~Chapter 3 as they relate to subcriticality of operations and margin of subcriticality for safety.

~~*Note:This is the acceptance criterion for reviewing the application and evaluating the high-risk accident sequences and a selected sampling of other than high-risk accident sequences.*~~ The ISA and supporting ISA documentation (such as piping and instrumentation diagrams, criticality safety analyses, dose calculations, process safety information, and ISA worksheets) would be maintained on site at an existing facility. For an applicant seeking a license before completion of a facility, a full level of detail concerning hardware, procedures, and programs usually would generally not exist. However, at the time of the preoperational readiness review for a new facility, or a new process at an existing facility, such details must be available to demonstrate compliance with the safety program requirements of Subpart H, "Additional Requirements for Certain Licensees Authorized To Possess a Critical Mass of Special Nuclear Material," of 10 CFR Part 70.

~~5.4.3.4.5 Requirements in 10 CFR 70.64(a)~~

~~The applicant's~~
The reviewer should consider the applicant's commitment to the baseline design criteria requirements in ~~10 CFR~~ 10 CFR 70.64(a) ~~should be considered~~ acceptable if the applicant for a license has met the following acceptance criteria or has identified and justified an alternative in the application:

- The applicant commits to the double-contingency principle in determining NCS controls and IROFS in the design of new facilities or new processes at existing facilities that require a license amendment under ~~10 CFR~~ 10 CFR 70.72.

~~(1) The applicant commits to double contingency protection as discussed in SRP Section 5.4.3.4.4(9).~~

~~5.4.3.4.6 Requirements in 10 CFR 70.65(b) (ISA Summary)~~

The applicant ~~is required to~~must meet the performance requirements in ~~10 CFR~~ 10 CFR 70.61(b) ~~and~~ and (c), as well as the performance requirements in ~~10 CFR~~ 10 CFR 70.61(d), which include the requirement to limit the risk of an inadvertent nuclear criticality by ~~assuring~~ensuring that all nuclear processes remain subcritical. The applicant's evaluation of NCS accident sequences ~~should~~may be performed in a manner consistent with the applicant's evaluation of non-NCS accident sequences used to meet ~~10 CFR~~ 10 CFR 70.61(b) and (c); however~~ 10 CFR~~, 10 CFR 70.61(d) requires the applicant to use prevention methods as the primary means to meet the performance requirements of 10 ~~CFR~~ CFR 70.61(b) ~~and~~ and (c). In addition, for new facilities and new processes at existing facilities, 10 CFR 70.64(a)(9) requires compliance with the double-contingency principle. This requires considerations in addition to those necessary to meet 10 CFR 70.61 for the noncriticality hazards.

The ~~applicant's~~reviewer should consider the applicant's commitment to the requirements in ~~10 CFR~~ 10 CFR 70.65(b) ~~should be considered~~ acceptable if the applicant has met the following acceptance criteria or has identified and justified an alternative in the application:

- The applicant meets the acceptance criteria in SRP ~~Section 3.4~~Section 3, as they relate to the ~~following:~~ identification of NCS accident sequences, consequences of NCS accident sequences, likelihoods of NCS accident sequences, and descriptions of IROFS for NCS accident sequences.

- The applicant ~~commits~~ should consider the upsets listed in Appendix A to ~~use Appendix A of~~ ANSI/ANS-~~-~~8.1~~-~~1983 in ~~determining~~identifying NCS accident sequences.

The applicant ~~commits to~~ may use the guidance in ANSI/ANS-8.10-1983, as modified by Regulatory ~~Guide~~ Guide 3.71, ~~August 1998,~~ in determining the consequences of ~~NCS~~criticality accident sequences. In general, such events should be considered "high consequence" events unless controls are in place to provide shielding or other isolation between the source of radiation and facility personnel. Consideration of events as other than high consequence should be justified in the ISA summary. The reviewer should note that the requirements of 10 CFR 70.61(d) are still applicable (i.e., criticality is to be prevented).

~~**5.4.3.4.7 Additional NCS Program Commitments**~~The application should also address the baseline design criteria (BDC) for new facilities or new processes at existing facilities that require a license amendment under 10 CFR 70.72. The baseline criteria must be applied to the design of new processes but do not require retrofits to existing facilities or existing processes; however, all facilities and processes must comply with the performance requirements in 10 CFR 70.61. NUREG-1601, Section 2.4, contains a list of items that should be considered in an adequate facility design. For new facilities and processes in existing facilities, the design must provide for adequate protection against criticality accidents.

~~The applicant's establishment of additional commitments regarding the NCS program should be~~

- The applicant ~~briefly~~ describes how the ISA was performed for the new process and how the ISA, satisfies the principles of the BDC and the performance requirements in 10 CFR 70.61. The applicant also explains how it applies defense-in-depth to higher risk accident sequences. Acceptable principles for defense-in-depth of the criticality safety

design are those that support a hierarchy of controls: prevention, mitigation, and operator intervention, in order of preference.

- The applicant describes proposed facility-specific or process-specific relaxations or additions to BDC, along with justifications for relaxations.
- The ISA summary describes how the criticality safety BDC were applied in establishing the design principles, features, and control systems of the new process.

5.4.3.2 NCS Program

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The reviewer should consider the applicant's management of the NCS program acceptable if the applicant has met the following acceptance criteria or has identified and justified an alternative in the application:

- The applicant describes and commits to implementing and maintaining an NCS program to meet the regulatory requirements of 10 CFR Part 70.
- The application states the NCS program objectives, which should include those objectives listed in this chapter.
- The application outlines an NCS program structure that is consistent with current industry practices (e.g., ANSI/ANS-8.1-1998 and ANSI/ANS-8.19-1996) and current industry practice that defines the responsibilities and authorities of key program personnel.
- The applicant commits to using the NCS program to establish and maintain NCS safety limits and NCS operating limits for fissile material use and possession and commits to maintaining management measures to ensure the availability and reliability of the controls.
- The applicant commits to preparation of NCS postings, to NCS training, and to NCS procedure training.
- The applicant commits to evaluating modifications to the facility or safety program for their impact on criticality safety.

Information related to NCS organization and administration acceptance criteria may be located in the organization and administration part of the application (see SRP Chapter 2). The reviewer should find the applicant's NCS organization and administration acceptable if the applicant has met the following acceptance criteria or has identified and justified an alternative in the application:

~~(1) The applicant commits to use the NCS program to promptly detect any NCS deficiencies by means of operational inspections, audits, or investigations, and to refer to the facility's corrective action function any unacceptable performance deficiencies in IROFS, NCS function, or management measures, so as to prevent recurrence.~~

~~(2) The applicant commits to support the facility change mechanism process by performing NCS determinations to evaluate changes to processes, operating procedures, IROFS, and management measures.~~

~~(3) The applicant commits to upgrade the NCS program to reflect changes in the ISA or new NCS methodologies and to modify operating and maintenance procedures in ways that could reduce the likelihood of occurrence of an inadvertent nuclear criticality.~~

~~(4) The applicant commits to retain records of NCS programs and to document any corrective actions taken.~~

~~(5) The applicant commits to use the NCS methodologies and technical practices in SRP Section 5.4.3.4 to evaluate NCS accident sequences in operations and processes.~~

- The applicant meets the acceptance criteria in SRP Section 2.4 as they relate to NCS, including organizational positions, functional responsibilities, experience, and qualifications of personnel responsible for NCS.
- The applicant meets the intent of ANSI/ANS-8.1 and ANSI/ANS-8.19 (see Regulatory Guide 3.71), as they relate to organization and administration.
- The NCS organization should be independent of operations to the extent practical.
- The applicant commits to provide distinctive NCS postings in areas, operations, work stations, and storage locations relying on administrative controls for NCS.
- The applicant commits to requiring its personnel to perform activities in accordance with written, approved procedures when the activity may impact NCS. Unless a specific procedure deals with the situation, personnel shall take no action until the NCS function has evaluated the situation and provided recovery procedures.
- The applicant commits to requiring its personnel to report defective NCS conditions to the NCS program management.
- The applicant describes organizational positions, experience of personnel, qualifications of personnel, and functional responsibilities.
- The applicant commits to designating an NCS program director who will be responsible for implementation of the NCS program.

Information related to NCS safety program acceptance criteria may appear in the ISA or management measures part of the application. The applicant's ~~description of measures to implement the facility change process requirements in 10 CFR 70.72~~ NCS management measures (required by 10 CFR 70.62) should be considered acceptable if the applicant has met the following acceptance criteria or has identified and justified an alternative in the application:
~~the application:~~

- training (see SRP Chapter 11)
  - The applicant meets the intent of ANSI/ANS-8.19 and ANSI/ANS-8.20 as they relate to training.
  - The applicant commits to training all personnel to recognize the CAAS signal and to evacuate promptly to a safe area.
  - The applicant commits to providing instruction and training regarding the policy in the SRP guidance for NCS organization
- procedures (see SRP Chapter 11)
  - The applicant commits to ANSI/ANS-8.19-1996 as it relates to procedures.
- audits and assessments (see SRP Chapter11)
  - The applicant commits to ANSI/ANS-8.19-1996 as it relates to audits and assessments.
  - The applicant commits to conducting and documenting walkthroughs (i.e., observation of operations to ensure compliance with criticality limits) of all operating special nuclear material (SNM) process areas such that all operating SNM process areas will be reviewed at some specified frequency. The reviewer should consider the complexity of the process, the degree of process monitoring, and the degree of reliance on administrative controls in assessing the acceptability of the specified frequency. Identified weaknesses should be referred to the facility corrective action function and should be promptly and effectively resolved. A graded approach may be used to justify an alternate NCS walkthrough schedule.
  - The applicant commits to conducting and documenting periodic NCS audits (such that all NCS aspects of management measures (see SRP Chapter 11) will be audited at least every 2 years. A graded approach may be used to justify an alternate NCS audit schedule.

The reviewer should consider the applicant's NCS technical practices acceptable if the applicant has met the following acceptance criteria or has identified and justified an alternative in the application:

- NCS evaluations will be performed using industry-accepted and peer-reviewed methods.

- NCS limits on controlled parameters will be established to ensure that all nuclear processes are subcritical, including an adequate margin of subcriticality for safety.

- Methods used to develop NCS limits will be validated to ensure that they are used within acceptable ranges and that the applicant used both appropriate assumptions and acceptable computer codes.

- The applicant commits to demonstrating (1) the adequacy of the margin of subcriticality for safety by ensuring that the margin is large compared to the uncertainty in the calculated value of k-eff, (2) that the calculation of k-eff is based on a set of variables within the method's validated area of applicability, and (3) that trends in the bias support the extension of the methodology to areas outside the area or areas of applicability.

  The margin of subcriticality for safety is an allowance for any unknown uncertainties that have not been accounted for in validation and a measure of the degree of confidence that systems calculated to be subcritical are actually subcritical. The margin is used to define an upper subcritical limit such that:

  k-subcritical = 1.0 – bias – bias uncertainty – margin of subcriticality for safety

  The reviewer must use judgment in assessing whether the margin of subcriticality for safety is sufficient to provide reasonable assurance of subcriticality (in accordance with 10 CFR 70.61(d)). The reviewer should consider the following factors, as applicable, in making this judgment, as well as any other available information that provides the needed confidence:

  – conservatism in the calculations, beyond that needed to accommodate uncertainties in the modeled parameters (e.g., geometric tolerances)

  – confidence in subcriticality generated by the applicant's validation process, including the following:

    ◦ similarity between the benchmark experiments and calculations to be performed

    ◦ sufficiency of the benchmark data (both quality and quantity)

    ◦ rigor of the validation methodology (e.g., trending, statistical testing)

- conservatism in the statistical parameters (e.g., 95/95 lower tolerance limit)

– sensitivity of the system to changes in modeled parameters (and therefore to errors)

– corroborating evidence of subcriticality from other sources (e.g., knowledge of neutron physics for well-characterized systems such as finished fuel)

– risk considerations, including the likelihood of actually attaining an abnormal condition

In general, a margin of subcriticality for safety of 0.05 has been found acceptable for typical nuclear processes involving low-enriched uranium, without a detailed justification. The use of increasingly smaller margins should require increasingly more rigorous justification, and other physical systems should be evaluated on a case-by-case basis.

- The applicant includes a summary description of a documented, reviewed, and approved validation report (by NCS function and management) for each methodology that will be used to perform an NCS analysis (e.g., experimental data, reference books, hand calculations, deterministic computer codes, probabilistic computer codes). The summary description of a reference manual or validation report should include the following:

  – A summary of the theory of the methodology that is sufficiently detailed and clear to allow understanding of the methodology, including the method used to select the benchmark experiments, to determine the bias and uncertainty in the bias, and to determine the upper subcritical limit.

  – A summary of the physical systems and area(s) of applicability covered by the validation report. It is not necessary to include the full range of numerical parameters that defines the area of applicability; a general description (e.g., low-enriched homogeneous UO_2F_2 solutions, low-enriched fuel pellets and rods containing gadolinia) is sufficient.

  – A description of the methods used to justify applying the methodology outside the area or areas of applicability.

  – A summary of the plant-specific benchmark experiments used to validate the methodology. It is not necessary to include all benchmark experiments used; a brief description of the individual benchmark data sets will suffice.

  – A description of the margin of subcriticality for safety and its justification.

  – A description of the controlled software and hardware used.

- A description of the verification process used, including verification upon changes to the calculational system and upon some specified period.

- The applicant's validation methodology, as described above, should be found acceptable if either (1) the applicant commits to following ANSI/ANS-8.24-2006, as endorsed by Regulatory Guide 3.71, or (2) the methodology follows current industry practices in terms of selecting the benchmark experiments, assessing their applicability, determining the area(s) of applicability, extending the area(s) of applicability beyond the range of benchmark data, and statistically analyzing the data. This requires that the NCS reviewer remain cognizant of current practices in the area of criticality code validation.

The reviewer may examine the applicant's validation report to ensure that the methodology is sufficiently rigorous and that the methodology is being applied in a manner consistent with its assumptions (e.g., normal distribution of benchmarks).

- The applicant commits to incorporating each validation report into the facility configuration management program.

- The applicant commits to performing NCS analyses in accordance with documented and approved procedures which incorporate the following principles:

  - NCS safety limits and NCS operating limits will be established assuming optimum credible conditions (i.e., the most reactive conditions physically possible or limited by written commitments to regulatory agencies) unless specified controls are implemented to control the limit to a certain range of values.

  - NCS safety limits, NCS operating limits, and limits on NCS-controlled parameters will be derived from the NCS analyses.

  - NCS operating limits will be derived from NCS safety limits by considering the uncertainty and variability in operating parameters to ensure that processes will remain subcritical under both normal and credible abnormal conditions.

  - The margin of subcriticality for safety for a process should be large relative to the uncertainty in the calculated value of k-eff.

Controlled parameters available for NCS control include the following: mass, geometry, density, enrichment, reflection, moderation, concentration, interaction, neutron absorption, and volume. The reviewer should consider the applicant's commitment to NCS technical practices acceptable if the applicant has met the following acceptance criteria or has identified and justified an alternative in the application:

- The applicant's use of a single NCS control to maintain the values of two or more controlled parameters constitutes only one component necessary to meet double-contingency protection.

- The applicant commits to the preferred use of passive engineered controls to ensure NCS. In general, the applicant should commit to the following order of preference for NCS controls: (1) passive engineered, (2) active engineered, (3) augmented administrative, and (4) simple administrative. When using other than a passive engineered control, the applicant should justify the choice of the type and manner.

- When they are relevant, the applicant should consider heterogeneous effects. Heterogeneous effects are particularly relevant for low-enriched uranium processes, where, all other parameters being equal, heterogeneous systems are more reactive than homogeneous systems.

The use of mass as a controlled parameter should be considered acceptable in the following circumstances:

- When mass limits are derived for a material that is assumed to have a given weight percent of SNM, determinations of mass are based on either (1) weighing the material and assuming that the entire mass is SNM or (2) conducting physical measurements to establish the actual weight percent of SNM in the material.

- When fixed geometric devices are used to limit the mass of SNM, a conservative process density is assumed in calculating the resulting mass.

- When the mass is measured, instrumentation subject to facility management measures is used.

The use of geometry as a controlled parameter should be considered acceptable if the following applies:

- Before beginning operations, all dimensions and nuclear properties that use geometry control are verified. The facility configuration management program should be used to maintain these dimensions and nuclear properties.

The use of density as a controlled parameter should be considered acceptable in the following circumstances:

- When process variables can affect the density, the ISA summary shows the process variables to be controlled by items relied on for safety (IROFS).

- Density is measured by the use of instrumentation subject to facility management measures.

The use of enrichment as a controlled parameter should be considered acceptable if the following apply:

- A method of segregating enrichments is used to ensure that differing enrichments will not be interchanged, or else the most limiting enrichment is applied to all material.
- Measurements of enrichment are obtained by using instrumentation subject to facility management measures.

The use of reflection as a controlled parameter should be considered acceptable in the following circumstances:

- In the evaluation of an individual unit, the wall thickness of the unit and all reflecting adjacent materials of the unit are considered. The adjacent materials should be farther than 30 centimeters (12 inches) from the unit.
- After all fixed reflectors are accounted for, the controls to prevent the presence of any transient reflectors (e.g., personnel) are identified as IROFS in the ISA summary.

The use of moderation as a controlled parameter should be considered acceptable if the following apply:

- When using moderation, the applicant commits to ANSI/ANS-8.22-1997.
- When process variables can affect the moderation, the ISA summary shows the process variables to be controlled by IROFS.
- Moderation is measured by using instrumentation subject to facility management measures.
- The design of physical structures precludes the ingress of moderation.
- When moderation needs to be sampled, dual independent sampling methods are used.
- Firefighting procedures for use in a moderation-controlled area restrict the use of moderator material.
- After evaluation of all credible sources of moderation for the potential for intrusion into a moderation-controlled area, the ingress of moderation is precluded or controlled.

The use of concentration as a controlled parameter should be considered acceptable in the following circumstances:

- When process variables can affect the concentration, the ISA summary shows the process variables to be controlled by IROFS.
- Concentrations of SNM in a process are limited unless the process is analyzed to be safe at any credible concentration.
- When using a tank containing concentration-controlled solution, the tank is normally closed and locked to prevent unauthorized access.
- When concentration needs to be sampled, dual independent sampling methods are used.
- After identification of possible precipitating agents, precautions are taken to ensure that such agents will not be inadvertently introduced.

The use of interaction as a controlled parameter should be considered acceptable if the following applies:

- To maintain a physical separation between units, engineered controls are used to ensure a minimum spacing; if engineered controls are not feasible, augmented administrative controls are used. The structural integrity of the spacers or racks should be sufficient for normal and credible abnormal conditions.

The use of neutron absorption as a controlled parameter should be considered acceptable in the following circumstances:

- When using borosilicate-glass raschig rings, the applicant commits to ANSI/ANS-8.5-1996.

When using fixed neutron absorbers, the applicant commits to ANSI/ANS-8.21-1995.

- ~~When using soluble neutron absorbers…~~
- In the evaluation of absorber effectiveness, neutron spectra are considered (e.g., cadmium is an effective absorber for thermal neutrons but ineffective for fast neutrons).

The use of volume as a controlled parameter should be considered acceptable if the following apply:

- Fixed geometry is used to restrict the volume of SNM.
- When the volume is measured, the instrumentation used is subject to facility management measures.

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The reviewer should consider the applicant's description of additional commitments for the NCS program acceptable if the applicant has met the following acceptance criteria or has identified and justified an alternative in the application:

- The applicant commits to using the NCS program to promptly detect any NCS deficiencies by means of operational inspections, audits, or investigations and to refer to the facility's corrective action function any unacceptable performance deficiencies in IROFS, NCS function, or management measures, so as to prevent recurrence.

- The applicant commits to supporting the facility change mechanism process by performing NCS evaluations to evaluate changes to processes, operating procedures, criticality controls, IROFS, and management measures.

- The applicant commits to retaining records of NCS deficiencies and to documenting any corrective actions taken.

- The reviewer should consider the applicant's description of measures to implement the facility change process requirements in 10 CFR 70.72 acceptable if the applicant has met the following acceptance criteria or has identified and justified an alternative in the application:

  – The applicant describes a change control process that is sufficient to ensure that the safety basis of the facility will be maintained during the lifetime of the facility. The change process should be documented in written procedures and should ensure that all ~~potentially affected~~changes to SNM processes are evaluated to determine the effect of the change on the safety basis of the process, including the effect on bounding process assumptions, on the reliability and availability of NCS controls, and on the NCS of connected processes. The change control process should ~~have~~include procedures for the review and approval of facility changes by the NCS function to determine the potential effects on NCS.

  – The change control process should be connected to the facility's configuration management system to ensure that changes to the NCS basis are incorporated into procedures, evaluations, postings, drawings, other safety basis documentation, and the ISA summary.

- The applicant's description of measures to implement the reporting requirements in Appendix A, "Reportable Safety Events," to 10 CFR Part 70 should be considered acceptable if the applicant has met the following acceptance criteria or has identified and justified an alternative in the application:

  – The applicant has a program for evaluating the criticality significance of NCS events and an apparatus in place for making the required notification to the NRC Operations Center. ~~The~~ Qualified individuals should make the determination of significance of NCS events ~~should be made by qualified individuals~~. The determination of loss or degradation of double–contingency protection should be made against the license and ~~10 CFR~~ Appendix A to 10 CFR Part 70 ~~Appendix A~~.

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– The applicant incorporates the reporting criteria of ~~Appendix A~~ Appendix A to 10 CFR Part 70 and the report content requirements of ~~10 CFR~~ 10 CFR 70.50, "Reporting Requirements," into the facility emergency procedures.

– The applicant commits to ~~issue~~issuing the necessary report based on whether the criticality controls and IROFS credited were lost (i.e., they were unavailable and unreliable to perform their intended safety functions), irrespective of whether the safety limits of the associated parameters were actually exceeded.

– ~~The applicant commits to the following:~~ If the licensee cannot ascertain within ~~one~~ 1 hour ~~of~~ whether the criteria of ~~10 CFR~~ 10 CFR Part 70, ~~Appendix~~ Appendix A ~~Paragraph~~, paragraph (a) or (b) apply, the applicant commits to treating the event ~~should be treated~~ as a ~~one~~1-hour reportable event.

~~5.5 REVIEW PROCEDURES~~ The applicant may use standards as a means to meet regulatory requirements. The U.S. Nuclear Regulatory Commission (NRC) Regulatory Guide 3.71, "Nuclear Criticality Safety Standards for Fuels and Materials Facilities," issued August 1998, endorses the American National Standards Institute/American Nuclear Society (ANSI/ANS) Series-8 national standards with some exceptions. NRC endorsement of these standards means that they provide procedures and methodology generally acceptable to the NRC staff for the prevention and mitigation of nuclear criticality accidents. However, application of a standard is not a substitute for detailed nuclear criticality safety analyses for specific operations.

If the applicant intends to conduct activities to which an NRC-endorsed standard applies, then the applicant should meet the intent of the standard. The applicant meets the intent of an NRC-endorsed standard by satisfying the following acceptance criteria:

- The license application contains a commitment to follow the requirements (i.e., "shall" statements) of the standard, subject to any exceptions taken by the NRC. The application clearly specifies the version of the standard and the specific provisions to which the applicant is committing.
- If there are requirements in a standard that the applicant does not commit to, the applicant provides sufficient information for the staff to determine if the requirements are not relevant to the applicant's activities or the license application contains other commitments that are equivalent.

If the licensee commits to a standard that has not been endorsed by the NRC, is not the most current version endorsed by the NRC, or is an unendorsed version of a previously endorsed standard, the license application should include justification for this commitment.

Regulatory Guide 3.71 endorses, in part or in full, the ANSI/ANS-8 national standards listed below.

- ANSI/ANS-8.1, "Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors," 1998
- ANSI/ANS-8.3, "Criticality Accident Alarm System," 1997
- ANSI/ANS-8.5, "Use of Borosilicate-Glass Raschig Rings as a Neutron Absorber in Solutions of Fissile Material," 1996
- ANSI/ANS-8.6, "Safety in Conducting Subcritical Neutron-Multiplication Measurements In Situ," 1983 (Reaffirmed in 1995)
- ANSI/ANS-8.7, "Guide for Nuclear Criticality Safety in the Storage of Fissile Materials," 1975 (Reaffirmed in 1987)
- ANSI/ANS-8.9, "Nuclear Criticality Safety Criteria for Steel-Pipe Intersections Containing Aqueous Solutions of Fissile Materials," 1987 (Reaffirmed in 1995)
- ANSI/ANS-8.10, "Criteria for Nuclear Criticality Safety Controls in Operations With Shielding and Confinement," 1983 (Reaffirmed in 1988)
- ANSI/ANS-8.12, "Nuclear Criticality Control and Safety of Plutonium-Uranium Fuel Mixtures Outside Reactors," 1987 (Reaffirmed in 1993)
- ANSI/ANS-8.15, "Nuclear Criticality Control of Special Actinide Elements," 1981 (Reaffirmed in 1995)
- ANSI/ANS-8.17, "Criticality Safety Criteria for the Handling, Storage, and Transportation of LWR Fuel Outside Reactors," 1984 (Reaffirmed in 1997)
- ANSI/ANS-8.19, "Administrative Practices for Nuclear Criticality Safety," 1996
- ANSI/ANS-8.20, "Nuclear Criticality Safety Training," 1991
- ANSI/ANS-8.21, "Use of Fixed Neutron Absorbers in Nuclear Facilities Outside Reactors," 1995
- ANSI/ANS-8.22, "Nuclear Criticality Safety Based on Limiting and Controlling Moderators," 1997
- ANSI/ANS-8.23, "Nuclear Criticality Accident Emergency Planning and Response," 1997
- ANSI/ANS-8.24, "Validation of Neutron Transport Methods for Nuclear Criticality Safety Calculations," 2007

- ANSI/ANS-8.26, “Criticality Safety Engineer Training and Qualification Program,” 2007

5.5.3.3 Safety Program

The reviewer should find the applicant’s criticality safety information acceptable if it provides reasonable assurance that the acceptance criteria presented below are adequately addressed and satisfied. The applicant may elect to incorporate some or all of the requested process information in the facility and process description (SRP Section 1.1) or the ISA summary, rather than in this section. Either approach is acceptable, as long as the information is adequately cross-referenced.

The regulation in 10 CFR 70.65(b)(3) requires a description of each process in the facility. This information must be included in the ISA summary. The applicant’s descriptions of the chemical processes are acceptable if they meet the following conditions:

- Process descriptions are sufficiently detailed to allow an understanding of the criticality to allow development of potential accident sequences
- Process descriptions are sufficiently detailed to allow an understanding of the theory of operation.

The regulation in 10 CFR 70.65(b)(4) requires information that demonstrates the licensee’s compliance with the performance requirements including a description of the management measures.

The use of accident sequences for providing the demonstration of compliance is acceptable in the following circumstances:

- The applicant provides a general description of the accident sequences identified in the ISA process for criticality hazards.
- The ISA summary describes the hazards identified in the ISA. Each accident sequence identified by the applicant in the ISA should include a criticality hazard evaluation of potential interactions and key assumptions. vessels, process equipment, and facility personnel. The hazard evaluation should use appropriate accepted methods.
- The applicant provides reasonable assurance that measures to mitigate the consequences of accident sequences identified in the ISA summary are consistent with actions described in SRP Chapter 8. (Note that some facilities are not required to have an emergency plan.)

The criticality accident consequences are acceptable if the following apply:

- The applicant assumes that all criticality accidents result in high consequences.

- The application includes definitions of “unlikely,” “highly unlikely,” and “credible” as used in the evaluations in the ISA.

The regulation in 10 CFR 70.65(b)(6) requires a list briefly describing all IROFS in sufficient detail to understand their functions in relation to the performance requirements.

The applicant provides in the ISA summary a list of criticality safety controls (i.e., IROFS) suitable to prevent criticality accidents. This list must also briefly describe the IROFS, in sufficient detail to permit an understanding of their safety functions. The applicant must demonstrate that the likelihood of each credible high-consequence event will be reduced after implementation of IROFS, so that the event will be highly unlikely.

If the applicant takes a graded approach to safety in accordance with 10 CFR 70.62(a), the reviewer should establish that the grading of IROFS is appropriate and sufficient to protect against criticality risks. For example, the applicant should consider reliance on passive controls of active systems and defense-in-depth in accordance with 10 CFR 70.64(b). To reduce common mode failures, the applicant should favor design features that use independent sources of motive force for items such as control actuators, jet pumps, eductors, and ejectors. Fail-safe controls are preferred unless safety concerns preclude this approach.

The applicant must review management measures to ensure the availability and reliability of IROFS and sole IROFS when they are required to perform their safety functions. Management measures may be graded commensurate with risk.

The application must meet the following criteria:

- The application must describe the engineering approach, basis, or schemes employed for maintaining safety in normal operations.
- The ISA summary must identify the administrative and engineered controls to prevent a criticality hazard. The applicant should also explain how any safety grading of IROFS and management measures has been made and how such grading is commensurate with the reduction in risk that the IROFS are designed to achieve.
- The application should demonstrate the management measures proposed to ensure that IROFS are available and reliable by briefly describing the following:
  - procedures to ensure the reliable operation of engineered controls (e.g., inspection and testing procedures and frequencies, calibration programs, functional tests, corrective and preventive maintenance programs, criteria for acceptable test results)
  - procedures to ensure that administrative controls will be correctly implemented, when required (e.g., employee training and qualification in operating procedures, refresher training, safe work practices,

development of standard operating procedures, training program evaluation)

5.5 Review Procedures

The reviewer should use the regulatory guidance of this chapter~~;~~, references in this chapter~~;~~, and the applicant's reports to the NRC (e.g., NRC Bulletin 91-01, ~~10 CFR~~ 10 CFR 70.50, and 10 CFR 70.74).

~~5.5.1~~ Acceptance Review

The primary reviewer should review the ~~applicant's~~applicant's NCS information for completeness with respect to the requirements in ~~10 CFR~~ 10 CFR 70.22, 70.24, 70.61, 70.62, 70.64, and 70.65, and the acceptance criteria in ~~Section~~ Section 5.4. If deficiencies are identified, then either the reviewer should ask the applicant ~~should be requested~~ to submit additional material before the start of the safety evaluation or the application should be denied.

~~5.5.2~~ Safety Evaluation

~~When an acceptable~~ After the application ~~is received from the applicant~~has been accepted, the primary reviewer should conduct a complete review of the application and determine ~~its acceptability.~~if it meets the requirements for approval specified in Section 5.4. The primary reviewer should consult with the supporting reviewers as appropriate to identify and resolve any issues of concern related to the licensing review. The primary reviewer should also coordinate with other primary reviewers of SRP ~~Chapters~~ Chapters 2, 3, 8, and 11 to confirm that the application meets all acceptance criteria pertinent to NCS ~~have been met.~~. The reviewer should also coordinate with other primary reviewers in radiation protection, chemical safety, and fire protection, as well as other disciplines as appropriate (e.g., seismic), to ensure appropriate consideration of any cross-cutting issues.

~~The primary reviewer for Chapter 5 should determine whether the acceptance criteria in SRP Section 5.4 have been met and should prepare the SER NCS chapter in accordance with SRP Section 5.6.~~**5.5.1 License Application**

~~5.6 EVALUATION FINDINGS~~The primary reviewer should review the applicant's NCS information in the license application for completeness with respect to the requirements in 10 CFR 70.22, 70.23, 70.24, 70.61, 70.62, 70.64, and 70.65, and the acceptance criteria in Section 5.4.

During the license application review the reviewer should identify and note any items or issues that should be inspected during an operational readiness review, if such a review will be performed. These items could include confirming that the commitments made in the license application are implemented though procedures and training.

If, during the review, the primary reviewer determines a need for additional information, the reviewer coordinates a request for additional information with the licensing project manager. The reviewer should ascertain that the criticality safety approach is consistent with other sections of the application, including those addressed by SRP Chapters 2, 3, 4, 6, 8, and 11.

For an existing facility, the reviewer may consult NRC inspectors to identify and resolve any issues related to the licensing review. These interactions should be coordinated through the licensing project manager.

The primary reviewer will prepare safety evaluation report (SER) input for the licensing project manager in support of the licensing action.

5.5.2 NCS Program

The reviewer should review all aspects of the applicant's NCS program including management, organization and technical practices. During the review the reviewer should identify and note any items or issues relating to the NCS program and commitments that should be inspected during an operational readiness review, if such a review will be performed. These items could include confirming that the commitments made in the license application are implemented though procedures and training.

If, during the review, the primary reviewer determines a need for additional information, regarding the NCS program the reviewer coordinates a request for additional information with the licensing project manager.

For an existing facility, the reviewer may consult NRC inspectors to identify and resolve any issues related to the NCS program commitments. These interactions should be coordinated through the licensing project manager.

5.5.3 Safety Program

The results of the ISA are the basis for the criticality safety evaluation. The reviewer should assess the criticality safety risks identified in the ISA summary and ensure that the level of safety is reflected in the design and the operational plans for the facility. The reviewer should establish that the applicant's facility design, operations, and IROFS for criticality safety provide reasonable assurance that they will function as intended, be available and reliable to perform their safety function, and provide for the safe possession and use of licensed material at the facility.

~~6.6 Evaluation Findings~~

~~The reviewer writes an SER input addressing each topic reviewed and explains why the NRC staff has reasonable assurance that the criticality safety portion of the application is acceptable. The reviewer may propose license conditions to impose requirements where the application is deficient. If unable to make a finding of reasonable assurance, the reviewer will prepare SER input explaining the deficiencies and the reasons for denying the proposed application. In cases where the SER is drafted in advance of resolving all outstanding criticality safety issues, the reviewer documents the review as described below and includes a list of open issues that require resolution before the staff can make a finding of reasonable assurance. For partial reviews, revisions, and process changes, the reviewer uses applicable sections of the acceptance criteria and the SER, and the reviewer notes areas that were not reviewed and the criticality safety significance, if any. On completion of the review, the NRC staff may impose temporary license conditions to authorize short duration activities. For certain functions and requirements that concern safety or regulatory issues, a license condition may be imposed and remain in effect until removed by an amendment or license renewal.~~

~~The SER should include a summary statement of what was evaluated and the basis for the reviewer's conclusions. The SER should include statements like the following:~~

~~The staff has evaluated the application using the criteria listed previously. Based on the review of the license application, the NRC staff has concluded that the applicant has adequately described and assessed accident consequences that could result from the handling, storage, or processing of licensed materials and that could have potentially significant chemical consequences and effects. The applicant has constructed a hazard analysis that identified and evaluated those criticality accident hazards and potential accidents and established safety controls to provide reasonable assurance of safe facility operation. To ensure that the performance requirements in 10 CFR Part 70 are met, the applicant has provided reasonable assurance that controls are maintained available and reliable when required to perform their safety functions. The staff has reviewed these safety controls and the applicant's plan for managing criticality safety through the NCS program and finds them acceptable.~~

~~The staff concludes that the applicant's plan for managing criticality safety and the criticality safety controls meet the requirements of 10 CFR Part 70 and provide reasonable assurance that the health and safety of the public will be protected.~~

5.6 Evaluation Findings

Note: ~~*The*~~ SRP Chapter 3 contains the evaluation ~~*finding*~~findings for the ISA ~~*Summary*~~summary requirements for ~~*10 CFR*~~10 CFR 70.65~~ *should be in SRP Section 3.6*~~.

If the staff's review verifies that ~~sufficient information has been provided in~~ the safety program description presents sufficient information to satisfy the acceptance criteria in SRP ~~Section~~ Section 5.4, the staff ~~should~~may document its review as follows:

> The staff has reviewed the Nuclear Criticality Safety (NCS) program and requirements for criticality safety for [name of facility] according to SRP Chapter 5. The staff has reasonable assurance that:
>
> - The applicant will have in place a staff of managers, supervisors, engineers, process operators, and other support personnel who are qualified to develop, implement, and maintain the NCS program in accordance with the facility organization and administration and management measures.
>
> - The ~~applicant's~~ applicant's conduct of operations will be based on NCS ~~methodologies and NCS~~ technical practices, which will ensure that the fissile material will be possessed, stored, and used safely according to the requirements in ~~10 CFR Part~~ 10 CFR Part 70.
>
> - The applicant will develop, implement, and maintain a criticality accident alarm system in accordance with both the requirements

in ~~10 CFR~~ 10 CFR 70.24 and the facility emergency management program.

- The applicant will have in place an NCS program ~~in accordance with the subcriticality of operations and margin of subcriticality for safety~~that meets the performance requirements in ~~10 CFR~~ 10 CFR 70.61(b), the subcriticality requirements~~s~~ in 10 CFR 70.61(d~~)~~), and the baseline design criteria requirements in ~~10 CFR~~ 10 CFR 70.64(a).

- Based on this review, the staff concludes that the applicant's NCS program meets the requirements of ~~10 CFR Part~~ 10 CFR Part 70 and provides reasonable assurance ~~for~~ of the protection of public health and safety, including that of workers, and the environment.

5.7 ~~REFERENCES~~References

H.~~-~~K. Clark~~,,~~ ", DP-1014, "Maximum Safe Limits for Slightly Enriched Uranium and Uranium Oxide~~,~~ ",~~"~~ Du Pont de Nemours and Co.~~-~~DP-1014, Aiken, SC, 1966.

R.~~-~~A. Knief, "Nuclear Criticality Safety——Theory and Practice," American Nuclear Society, La Grange Park, IL, 1985.

H.~~-~~C. Paxton and N.~~-~~L. Pruvost, LA-10860-MS, "Critical Dimensions of Systems Containing ^{235}U, ^{239}Pu, and ^{233}U," Los Alamos National Laboratory, Los Alamos, NM, 1987.

N.~~-~~L. Pruvost and H.~~-~~C. Paxton, LA-12808/UC-714, "Nuclear Criticality Safety Guide," Los Alamos National Laboratory, Los Alamos, NM, 1996.

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U.S. Code of Federal Regulations, Chapter I, Title 10, "Energy," Part 70, ~~-~~"Domestic Licensing of Special Nuclear Material~~,' U.S. Government Printing Office, Washington, DC.~~."

U.S. Department of Energy, DOE Order 420.1 (Change 2), "Facility Safety," ~~October~~ October~~r~~ 24~~,~~, 1996.