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August 18, 1999

Mr. Theodore S. Sherr
Chief, Regulatory and International Safeguards Branch
U.S. Nuclear Regulatory Commission
Two White Flint North 8A33
Washington, D.C. 20555

Reference: Comments on the June, 1999 Draft Version of NUREG-1520 '*Standard Review Plan for the Review of a License Application for a Fuel Cycle Facility*': Chapter 5 – Nuclear Criticality Safety

Dear Mr. Sherr:

The Nuclear Energy Institute (NEI)[1] and its industry members are undertaking detailed reviews of each chapter of the draft Standard Review Plan (SRP) released on June 2, 1999 as part of SECY-99-147. To provide effective guidance on implementation of 10 CFR 70, we believe the SRP should be concisely written and accurately reflect the 'risk-informed, performance-based' regulatory approach incorporated into the Part 70 rule revisions.

Accompanying this letter are NEI's comments on Chapter 5 ('*Nuclear Criticality Safety*') of the draft SRP. The review is presented in two parts: (i) general comments on the sub-chapter, and (ii) specific language (or stylistic) improvements presented on a red-lined version of the draft SRP sub-chapter. In view of the number and complexity of NEI's proposed improvements, a second copy of SRP Chapter 5 has been prepared from which the red-lined text deletions have been

[1] NEI is the organization responsible for establishing unified nuclear industry policy on matters affecting the nuclear energy industry, including the regulatory aspects of generic operational and technical issues. NEI's members include all utilities licensed to operate commercial nuclear power plants in the United States, nuclear plant designers, major architect/engineering firms, fuel fabrication facilities, materials licensees, and other organizations and individuals involved in the nuclear energy industry.

removed. This version of draft SRP Chapter 5 will enable you to more clearly understand the improvements which NEI is recommending.

NEI is pleased that many improvements to the draft SRP developed in public meetings and workshops and proposed by industry have been incorporated into this latest draft of the SRP. The June, 1999 revision is markedly improved over earlier versions issued in 1998 and we compliment the staff for this accomplishment.

We look forward to working with you and your staff to make NUREG-1520 a clear and concise document that will facilitate implementation of the new provisions of 10 CFR Part 70. Please feel free to contact me should you have any questions concerning the proposed improvements in the attachment to this letter.

Sincerely,

Felix M. Killar, Jr.
Director, Material Licensees and Nuclear Insurance

c. Mr. Marvin S. Fertel
Dr. Carl J. Paperiello, Director NMSS

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COMMENTS ON THE JUNE, 1999 DRAFT VERSION OF NUREG-1520 '*STANDARD REVIEW PLAN FOR THE REVIEW OF A LICENSE APPLICATION FOR A FUEL CYCLE FACILITY*'

CHAPTER 5: NUCLEAR CRITICALITY SAFETY (NCS)

I. General Comments

The latest version of draft SRP Chapter 5 addresses the principal concerns that NEI raised before the NRC at the March 24-25, 1999 Public Meeting on NCS and in NEI's letters of December 17, 1998 and January 21, 1999. Removal of much of the prescriptiveness from the November, 1998 version of Chapter 5 and replacement with a strong focus on an applicant's commitments to performance goals is a notable improvement. The expressed willingness of the NRC to accept an applicant's commitment to either industry-accepted or ANSI standards, rather than to require lengthy discourses in the application on how a particular procedure will be met, is another commendable improvement.

Our remaining concerns with draft SRP Chapter 5 focus on the need for a clearer definition of the scope of the reviewer's assessment and, in particular, to prevent duplicate reviews of the ISA, ISA Summary (Chapter 3) and Organization and Administration (Chapter 2) as they apply to NCS. As written, the scope of the reviewer's assessment remains too broad and duplicative.

As NEI has mentioned in comments on other SRP chapters, Chapter 5 should focus the reviewer even more on an assessment of the applicant's ***commitments*** to design and implement an NCS program, and not on the details of how the program will be implemented. On several occasions, NEI has excerpted language from the draft SRP for the AVLIS facility (draft NUREG-1701) where such language is more clearly and succinctly expressed than in draft NUREG-1520.

In §5.5.3 ('Areas of Review') the reviewer must be directed to review for familiarity, but not to approve, the results of the ISA (as summarized in the ISA Summary) pertaining to NCS-related processes. Similarly, the reviewer must review, but not approve, the facility's proposed organization and administration (SRP Chapter 2) to understand how the NCS program fits into the overall plant management.

Several instances remain where the SRP accepts an applicant's commitment to an ANSI standard, but then seeks even broader commitments. For example, the second paragraph of §5.4 states that an applicant's commitments to adhere to an NRC-endorsed standard constitute "*...an acceptable NCS program...*". But the guidance then requests "*...more specific commitments in the application...*" ANSI/ANS 8 series standards are sufficiently detailed that such additional commitments should not be necessary. Inclusion of such additional information in the safety demonstration section of the license would be more appropriate.

There are several instances in which draft SRP Chapter 5 requires commitment to a principle or condition that is already contained in an ANSI/ANS 8 standard. There is, therefore, no need for re-commitment to something already embraced in the standard. Such duplicative statements should be removed. For example:

(i) §5.4.3.2(2b) is part of ANSI/ANS-8.1 and is not needed ("*The applicant commits to provide instruction in the Training program regarding the use of Process Variables as NCS controls*")

(ii) §5.4.3.3.2(1) is a statement of practice rather than an acceptance criterion and should be deleted ("*Although the applicant may use a single NCS control to maintain the values of two or more Controlled Parameters, this use constitutes only one component necessary for Double Contingency Protection")*

(iii) §5.4.3.3.2(7) and (8): These two statements are contained in ANSI/ANS-8and need not be repeated in this section of Chapter 5

On nineteen occasions the SRP requires the applicant to "*…commit to the requirements …*" of an ANSI/ANS-8 standard. Such an all-encompassing, blanket commitment to adhere to every detail of the standard is unnecessarily broad. Specific elements of a standard may not be appropriate for every license applicant and may not be required for a facility operation based upon the results of the ISA. NEI recommends, therefore, that the SRP language be revised to cite a specific ANSI/ANS (or comparable industry standard) as guidance to the applicant in preparing license commitments. The applicant should not, however, be inextricably bound to adhere to every detailed provision and element of the standard, but rather only to its broad principles and to those detailed elements dictated by the results of the ISA to be important for minimizing risks to human health and safety and the environment. In other words, an applicant's commitments should be *consistent with* the guidance provided in the standard (or regulatory guide).

NEI has recommended clarification and tightening up of the draft language throughout the draft. In several sub-chapters the content has not been materially changed, but the order of presentation of information has been improved to make the requirements flow more logically.

Many of NEI's comments have been prompted by the need to more closely tie the NCS program to the ISA. The two are inextricably linked. The failure of the draft SRP to link the results of the ISA to the requirements for the NCS program is a deficiency we have tried to correct

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II. Specific Comments

Specific comments are noted on the attached copy of draft SRP Chapter 5.

5.0 NUCLEAR CRITICALITY SAFETY (NCS)

[Comment: SRP Chapter 5 should include some introductory remarks to clearly define the scope of the reviewer's assessment of the NCS program. The preface must state that the design of the NCS program is based upon the results of the ISA. It must also state that review of accident sequences (with potential nuclear criticality implications), items relied on for safety and management measures was already conducted as an SRP Chapter 3 task and does not need to be repeated as a Chapter 5 task. Similarly, organizational and administrative issues pertaining to the NCS program were primarily considered in Chapter 2 and need not be assessed again in Chapter 5. The preface should emphasize that the Chapter 5 review must focus on evaluation of an applicant's commitments to design, implement and maintain an NCS program rather than on specific details as to how program objectives will be achieved. Lastly, NEI believes Chapter 5 can be better focused and shortened and structured identically to Chapter 4. Both chapters detail facility safety programs ('*Radiation Protection'* or *'Nuclear Criticality Safety*') for worker protection.]

5.1 PURPOSE OF REVIEW 5.1PURPOSE OF REVIEW

The purpose of this review is to determine whether the applicant ~~, in the license application and supported by materials on the docket,~~ has made ~~the~~appropriate commitments to develop, implement, and maintain an NCS program in support of safe operation of the facility as required by 10 CFR 70.~~generally by Federal Regulations and specifically by 10 CFR 70.24, 70.61, 70.62, 70.64, and 70.65.~~ [Comment: NEI recommends that specific rule citations be made in the '*Regulatory Requirements*' section of each review topic. Leave the Introduction general in scope.]

Development of the NCS program is based upon the results of the ISA. The NCS program must enable derivation of NCS safety limits and NCS operating limits for facility processes evaluated in the ISA to have nuclear criticality hazards. It must also serve as the mechanism to ensure that items relied on for safety and their associated management measures remain adequate for nuclear processes. Finally, the NCS program must be capable of evaluating NCS implications for facility changes that are evaluated in updates or revisions of the ISA .

The ISA, as summarized in the ISA Summary, was evaluated in SRP Chapter 3 ('*Integrated Safety Analysis (ISA) Commitments and ISA Summary*'). The ISA identified and evaluated the potential risk of accident sequences that could result in conditions leading to an inadvertent nuclear criticality. Nuclear criticality analyses were performed in the ISA to establish NCS safety limits and NCS operating limits and to identify appropriate items relied on for safety to prevent or mitigate such accident sequences. Finally, the ISA recommended management measures to enhance NCS by ensuring the availability and reliability of the items relied on for safety.

The NCS program review entails assessment of the following components:

(1) program objectives
(2) operational plans, administrative practices and technical criteria to perform NCS studies
(3) management and organizational structures to execute the program
(4) procedures to maintain double contingency for NCS (under normal conditions and credible accident conditions)
(5) procedures to maintain a reliable criticality accident alarm system and corresponding emergency procedures

(6) procedures to control items relied on for safety and management measures for maintenance of NCS.

Prior to evaluating the applicant's NCS program, the reviewer should first consult the ISA Summary (Chapter 3 of the application) to gain familiarity with:

(1) the accident sequences in each area of the plant that could result in an inadvertent nuclear criticality, including the effects of external initiating events
(2) the specific items relied on for safety (controls or barriers) recommended to provide reasonable assurance that an inadvertent nuclear criticality will not occur, and
(3) the management measures recommended to ensure the NCS items relied on for safety will operate when required (e.g. receipt of adequate levels of maintenance, training in their operation, etc.)

The reviewer should also consult Chapter 2 of the application ('*Organization and Administration*') to gain familiarity with the applicant's management policies, administrative programs and organizational commitments to support the NCS program.

5.2 RESPONSIBILITY FOR REVIEW5.2RESPONSIBILITY FOR REVIEW

Primary: Nuclear Process Engineer (NCS Reviewer)

Secondary: None

Supporting: Project Manager and Fuel Cycle Inspector (As needed.)

5.3 AREAS OF REVIEW 5.3AREAS OF REVIEW

The staff should review an applicant's NCS program commitments in the following areas:

(1) commitment to develop and implement an NCS program having the following objectives:

- prevention of inadvertent nuclear criticalities
- protection against accident sequences identified in the ISA that could lead to inadvertent nuclear criticalities
- compliance with the NCS performance requirements of 10 CFR 70.61
- establishment of NCS safety parameters and procedures
- establishment and maintenance of adequate NCS safety and NCS operating limits for items relied on for safety
- performance of NCS analyses to ensure all nuclear processes remain subcritical and operate with an acceptable margin of sub-criticality
- provision of continuing assurance that items relied on for safety and management measures are adequate and acceptable
- instruction of plant personnel in NCS and emergency procedures to respond to inadvertent critical excursions
- compliance with NCS Baseline Design Criteria for new processes at existing facilities that require a license amendment under 10 CFR 70.72

- selection of appropriate items relied on for safety and management measures (e.g. training, monitoring, testing, maintenance) based on updated NCS determinations

(2) commitment to establish an NCS program organization and administrative structure including:
- appointment of staff who are suitably qualified and trained in NCS
- description of the responsibilities and authorities of each key appointment
- provision of sufficient resources to develop, implement and maintain the program

(3) commitment to identify and use appropriate NCS methodologies and NCS technical practices to conduct NCS analyses of plant operations

(4) commitment to: (i) audit, assess and upgrade the NCS program, if required, (ii) use the NCS program in revisions of the ISA, and (iii) recommend modifications to plant operating and maintenance procedures to reduce the likelihood of occurrence of an inadvertent nuclear criticality.

(5) commitment to design and install a Criticality Accident Alarm System (CAAS) to provide immediate detection and annunciation of a nuclear criticality

(6) commitment to refer to the facility's corrective action program any unacceptable performance deficiencies that might (or did) result in an inadvertent nuclear criticality

(7) commitment to retain records of NCS programs and to document corrective actions taken

~~the application to determine whether (1) the applicant has identified and committed to the responsibilities and authorities for individuals to develop and implement the NCS program; (2) the facility management measures described in 10 CFR 70.62 have been committed to and will support implementing and maintaining the NCS program; (3) an adequate NCS program is described which includes identifying and committing to the Methodologies and Technical Practices used to ensure the safe operation of the facility as required by 10 CFR 70.24 [Criticality Accident Alarm System (CAAS)], 10 CFR 70.61 [Subcriticality of Operations and Margin of Safety for Subcriticality], 10 CFR 70.64 [Baseline Design Criteria (BDC)], and 10 CFR 70.65 [ISA Summary].~~

Each of the applicant's NCS program commitments will be examined in the Chapter 5 review.

[Comment: the balance of this §5.3 can be deleted for clarity and SRP chapter simplification.]

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

~~5.3.1 Organization and Administration 5.3.1Organization and Administration~~

~~The Primary Reviewer should review the Organization and Administration application to determine whether the has identified and committed to the responsibilities and authorities for individuals to develop and implement the NCS program. The following areas of the application related to the applicant's Organization and Administration should be reviewed:~~

~~1) For familiarity, the general Organization and Administration methods used by the applicant (see Section 2.0).~~

2) The areas of review listed in Section 2.3.1 (Organization and Administration) as they relate to NCS.

3) Experience and education requirements of NCS management positions.

5.3.2 Management Measures 5.3.2Management Measures

The Primary Reviewer should review the application to determine whether the facility management measures in 10 CFR 70.62 have been committed to by the applicant and whether they demonstrate the applicant's ability to implement and maintain the NCS program. [Comment: there could be confusion here between '*management measures*', which are applied to items relied on for safety (as identified in the ISA), and '*management policies*' that will provide the reviewer the assurance that the facility will maintain an NCS program. Chapter 5 does not entail evaluation of the former, rather just the latter.] The following areas of the application related to the applicant's Management Measures should be reviewed:

1. Configuration Management, Procedures, Audits and Assessments, Incident Investigations, and other quality assurance elements used by the applicant (see SRP Sections 11.1 through 11.8).

2. The Training, Procedures, and Audits and Assessments programs specifically related to NCS.

5.3.3 Methodologies and Technical Practices 5.3.3Methodologies and Technical Practices

The Primary Reviewer should review the application to determine whether the applicant has implemented NCS Methodologies and NCS Technical Practices used to make NCS determinations to ensure the safe operation of the facility as required by 10 CFR 70.24 [CAAS], 10 CFR 70.61(d) [Subcriticality of Operations and Margin of Safety for Subcriticality], 10 CFR 70.64(a)(9) [BDC], and 10 CFR 70.65(b) [ISA Summary]. The following areas of the application related to the applicant's NCS Methodologies and NCS Technical Practices should be reviewed:

1. The commitment to use the NCS Methodologies identified by the applicant's NCS program.
2. The commitment to use the NCS Technical Practices identified by the applicant's NCS program.

3. The commitment to fulfill the requirements of 10 CFR 70.24 (CAAS) and to have a CAAS that has been incorporated into the Management Measures.

4. The commitment to detect an inadvertent nuclear criticality and promptly notify personnel which should ensure that the radiation exposure to workers shall be minimized.

5. The commitment to the requirements of 10 CFR 70.61 (Subcriticality of Operations and Margin of Subcriticality for Safety).

6. The commitment to the requirements in 10 CFR 70.64 (BDC) as they relate to NCS.

7. The areas of review listed in Section 3.3 (ISA Summary) as they relate to NCS.

5.4 ACCEPTANCE CRITERIA 5.4ACCEPTANCE CRITERIA

[Comment: NEI recommends that the Acceptance Criteria be restructured to address each of the NCS program commitments enumerated in §5.3. Introducing §5.4 with the general statement of acceptability of NCS standards is excellent and should remain.]

The applicant's NCS program is acceptable if the following acceptance criteria have been met: ~~To provide for NCS, 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 where a standard applies and the standard has been endorsed by an NRC Regulatory Guide, then a commitment to comply with all of the requirements (i.e., "shalls") and the appropriate recommendations (i.e., "shoulds") of the standard should constitute an acceptable program under the NRC regulations with respect to the safety aspects addressed by the standard. ~~Notwithstanding such a general commitment to a standard, the licensee should clarify broad requirements in the standard by more specific commitments in the application.~~[Comment: the SRP states that an applicant's commitments to an NRC-endorsed standard constitute an acceptable NCS program, but then requests "…*more specific commitments in the application*…" ANSI/ANS-8 standards are sufficiently detailed that such additional commitments are not necessary. Delete this sentence.] Any variations from the requirements of the standard should be identified and justified in the application.

Individual commitments to the Acceptance Criteria are expected only when the Acceptance Criteria are relevant to the operations and materials to be licensed.

5.4.1 Regulatory Requirements5.4.1Regulatory Requirements

The regulatory basis for the review should be the general and additional contents of an application as required by 10 CFR 70.22 and 70.65, respectively. In addition, the NCS review should be conducted to ensure compliance with 10 CFR 70.24, 70.61, and 70.62.

5.4.2 Regulatory Guidance5.4.2Regulatory Guidance

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

1. ANSI/ANS-8.1-1983 (Reaffirmed in 1988), *"Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors."*

2. ANSI/ANS-8.3-1997, *"Criticality Accident Alarm System."*

3. ANSI/ANS-8.5-1996, *"Use of Borosilicate-Glass Raschig Rings as a Neutron Absorber in Solutions of Fissile Material."*

4. ANSI/ANS-8.6-1983 (Reaffirmed in 1995), *"Safety in Conducting Subcritical Neutron-Multiplication Measurements In Situ."*

5. ANSI/ANS-8.7-1975 (Reaffirmed in 1987), *"Guide for Nuclear Criticality Safety in the Storage of Fissile Materials."*

6. ANSI/ANS-8.9-1987 (Reaffirmed in 1995), *"Nuclear Criticality Safety Criteria for Steel-Pipe Intersections Containing Aqueous Solutions of Fissile Materials."*

7. ANSI/ANS-8.10-1983 (Reaffirmed in 1988), *"Criteria for Nuclear Criticality Safety Controls in Operations With Shielding and Confinement."*

8. ANSI/ANS-8.12-1987 (Reaffirmed in 1993), *"Nuclear Criticality Control and Safety of Plutonium-Uranium Fuel Mixtures Outside Reactors."*

9. ANSI/ANS-8.15-1981 (Reaffirmed in 1995), *"Nuclear Criticality Control of Special Actinide Elements."*

10. ANSI/ANS-8.17-1984 (Reaffirmed in 1997), *"Criticality Safety Criteria for the Handling, Storage, and Transportation of LWR Fuel Outside Reactors."*

11. ANSI/ANS-8.19-1996, *"Administrative Practices for Nuclear Criticality Safety."*

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

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

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

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

5.4.3 Regulatory Acceptance Criteria5.4.3Regulatory Acceptance Criteria

5.4.3.1 Commitment to NCS Program Implementation

The reviewer will determine that the applicant's NCS program commitment is adequate if it fulfills the following criteria:

(1) the applicant commits to develop, implement and maintain an NCS program to meet the regulatory requirements of 10 CFR 70
(2) the applicant states the program objectives, which should include the commitment to prevent inadvertent nuclear criticalities, to protect against accident sequences analyzed in the ISA that could result in a nuclear criticality, to maintain plant operations in a subcritical state and with an acceptable margin of sub-criticality and to maintain compliance with the NCS performance requirements of 10 CFR 70.61
(3) the applicant establishes NCS safety parameters and procedures
(4) the applicant outlines an NCS program structure and defines the responsibilities and authorities of key program personnel
(5) the applicant commits to maintain current the facility's NCS methodologies and NCS technical practices by means of the plant's configuration management program
(6) the applicant commits to use the NCS program to establish and maintain NCS safety and NCS operating limits for items relied on for safety in nuclear processes and to maintain the adequacy of management measures to ensure their availability and

reliability (e.g. ensure the maintenance or NCS items relied on for safety, training , inspections and audits to correct deficiencies, evaluation of changes to the NCS program, etc.)

(7) the applicant commits to preparation of NCS postings and to the training in NCS and emergency procedures of plant personnel working in nuclear processes

(8) the applicant commits to adhere to applicable NCS baseline design criteria in the design of new processes at existing facilities that require a licnse amendment under 10 CFR 70.72

(9) the applicant commits to use the NCS program to evaluate, within the framework of the ISA, any modifications to plant operations, to recommend process parameter changes to maintain the safe operation of the facility and to select appropriate items relied on for safety and management measures

5.4.3.2~~1~~ Organization and Administration

The reviewer will determine that the applicant's commitment to organize and staff an NCS program is acceptable if it fulfills the following criteria:

~~To provide for NCS, the applicant's 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 (information related to these Acceptance Criteria may be consolidated with other Organization and Administration descriptions elsewhere in the application in response to Chapter 2.0):~~

~~1. The applicant meets the Acceptance Criteria related to NCS in Section 2.4.1 (Organization and Administration)~~. [Comments: (1) this evaluation was performed as a Chapter 2 task and need not be repeated in Chapter 5, (2) §2.4.1 is entitled '*Regulatory Requirements*' and not '*Organization and Administration*'. Delete the incorrect parenthetical.]

~~(1)~~ ~~(2)~~ The applicant commits to organize and administer the NCS program consistent with the guidance provided ~~the requirements~~ in ANSI/ANS-8.1-1983, *"Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors."* and ~~(3) The applicant commits to the requirements in~~ ANSI/ANS-8.19-1996, *"Administrative Practices for Nuclear Criticality Safety."*

[Comment: the applicant has previously committed to the requirements of ANSI/ANS-8.1, including Section 4.11. There is, therefore, no need to require re-commitment to this standard. This paragraph is redundant and should be deleted.] ~~The applicant commits to the intent of Section 4.11 of ANSI/ANS-8.1-1983, which is: The applicant shall commit to the use of 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.~~

(2) The applicant commits to describe organizational positions, experience and qualifications of personnel, functional responsibilities and to outline organizational relations amongst the individual positions

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

(5) The applicant commits to provide NCS postings for areas, operations, work stations, and storage locations that provide operators a reference for ensuring conformance and safe operation. [Comment: The terms '*areas*', '*operations*', '*work stations*' and '*storage locations*' are undefined. To require postings for these undefined areas is inappropriate. The language implies that conformance and safe operation can be insured by a posting that may or may not list all of the NCS controls. Postings are useful on a case-by-case basis, but should not be required for every fissile operation. The applicant should be allowed wide latitude in the selection and use of postings. Delete this paragraph 5.]

(4)(6) [Comment: the double negative in the following sentence should be removed. Simplify this paragraph 6 to read as follows.] The applicant commits to the policy that: "Personnel shall report defective NCS conditions and perform actions only in accordance with approved, plant procedures All personnel shall report defective NCS conditions to the NCS function and take no further action not specified by approved written procedures until NCS has analyzed the situation."

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

5.4.3.2 Management Measures5.4.3.2Management Measures

[Comment: §5.4.3.2 seems unnecessary in Chapter 5. There is confusion between the term '*management measures*' and what might be better referred to as "*NCS management policies*." The management measures cited in 10 CFR 70.62 pertain to items relied on for safety that were proposed for accident sequences evaluated in the ISA. The acceptability of such management measures was assessed as a Chapter 3 task and need not be repeated here. Delete this section.]To provide for NCS, the applicant's 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 (information related to these Acceptance Criteria may be consolidated with other Training descriptions in the application in response to SRP Section 11.3): [Comment: commitment to training is stated in §5.4.3.1(6) above.]

   a. The applicant commits to the requirements in both ANSI/ANS-8.19-1996, *"Administrative Practices for Nuclear Criticality Safety"* and ANSI/ANS-8.20-1991, *"Nuclear Criticality Safety Training."*

   b. The applicant commits to provide instruction in the Training program regarding the use of Process Variables as NCS controls. [Comment: ANSI/ANS-8.20 section 7.6.3 encompasses the requirement for training in process parameter control and need not be identified in a separate section 1(b). This type of training need only be provided to plant personnel who are actually in a position that requires control of such nuclear process parameters.]

   c. The applicant commits to provide instruction in the Training program regarding all personnel to (1) recognize the CAAS signal and (2) evacuate promptly to a safe area. [Comment: the commitment to establishing a CAAS system is discussed below in §5.4.3.3.4. Delete this program reference.]

d. The applicant commits to provide instruction in the Training program regarding the policy that: "All personnel shall report defective NCS conditions to the NCS function and take no further action not specified by approved written procedures until NCS has analyzed the situation." [Comments: (1) the commitment to training is stated in §5.4.3.1(6) and §5.4.3.1(8)above, (2) the content of this paragraph has already been stated in §5.4.3.2.1 (above) and need not be repeated again. Delete this paragraph.]

2. Procedures (information related to these Acceptance Criteria may be consolidated with other Procedures descriptions elsewhere in the application in response to Section 11.4):

a. The applicant commits to the requirements in ANSI/ANS-8.19-1996, *"Administrative Practices for Nuclear Criticality Safety."* [Comment: this commitment has been relocated to §5.4.3.2(1).]

b. The applicant commits to the policy that: "No single, inadvertent departure from a procedure could cause an inadvertent nuclear criticality." [Comment: delete the redundant adjective '*inadvertent*.' A nuclear criticality is a nuclear criticality, whether caused deliberately or inadvertently. This clause has been relocated to §5.4.3.1]

3. Audits and Assessments (information related to these Acceptance Criteria may be consolidated with other Audit and Assessment descriptions elsewhere in the application in response to Section 11.5):

a. The applicant commits to the requirements in ANSI/ANS-8.19-1996, *"Administrative Practices for Nuclear Criticality Safety."*

[Comment: the SRP should not prescribe the frequency of walkthroughs or audits. Weekly walkthroughs could be a great burden without commensurate benefit. The prescription of auditing all NCS aspects of management measures every two years may not be feasible, as some NCS operations may not be performed that often. The applicant should determine the appropriate frequency of walkthroughs and audits, based on the results of the ISA, experience, and industry standards and practices. While documentation of each NCS inspection by plant personnel and referral of identified deficiencies to the corrective action program constitute excellent plant practices, Sections (b) and (c) of this §5.4.3.2(3) should be deleted.]

b. The applicant commits to conducting and documenting Weekly NCS Walkthroughs (e.g., checklists) of all operating SNM process areas such that all operating SNM process areas should be reviewed at least every two weeks. Identified weaknesses should be incorporated into the facility Corrective Actions Program and should be promptly and effectively resolved. A graded approach may be used to justify an alternate plan based on the ISA.

c. The applicant commits to conducting and documenting Quarterly NCS Audits such that all NCS aspects of Management Measures (see Sections 11.1 through 11.8) should be audited at least every 2 years. A graded approach may be used to justify an alternate plan based on the ISA.

5.4.3.3 Methodologies and Technical Practices5.4.3.3Methodologies and Technical Practices

The reviewer should evaluate the applicant's NCS technical procedures to ensure that the following elements have been addressed:

(1) NCS evaluations are performed using acceptable methodologies
(2) NCS safety and NCS operating limits on items relied on for safety are developed in an acceptable manner
(3) NCS controlled parameters are appropriately used and applied
(4) analytical methods used to develop NCS limits are validated

5.4.3.3.1 NCS Evaluations ~~Methodologies5.4.3.3.1Methodologies~~

The reviewer is to evaluate the applicant's technical practices to ensure that the following elements have been adequately addressed:

(1) criticality safety evaluations will be performed using acceptable methodologies
(2) NCS limits on controls and controlled parameters will be established to ensure an adequate margin of safety
(3) analytical methods used to develop NCS limits will be validated, including assurance that they are used within acceptable ranges, with appropriate assumptions and with acceptable computer codes
(4) nuclear criticalities are detected promptly to ensure that radiation exposures to workers are minimized

[Comment: the content of §5.4.3.3.1 should be rearranged to flow in a more logical manner. Information should be presented in this sequence: (1) commitment to prepare and maintain manuals and reports on acceptable NCS Methodologies at the facility, (2) commitments pertaining to the use of each methodology, (3) and inclusion of a summary of the accepted methodologies in the license application. The treatment of NCS methodologies in the SRP bears close resemblance to the manner in which the "*ISA*" and "*ISA Summary*" are addressed in both SRP Chapter 3 and 10 CFR Parts 70.62 and 70.65. Section 5.4.3.3.1 has been reorganized as follows.]

~~To provide for NCS, the~~ The applicant's commitment to conduct NCS evaluations ~~NCS Methodologies~~ should be considered acceptable if it fulfills the following criteria: ~~the applicant has met the following Acceptance Criteria or has identified and justified an alternative in the application:~~

1. The applicant commits to conduct NCS evaluations consistent with the guidance provided ~~the requirements~~ in ANSI/ANS-8.1-1983, *"Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors."*

2. The applicant commits to prepare and maintain at the facility reference manuals or management-approved validation reports for each NCS methodology that is used to make an NCS determination. The manual or validation report should include:

   a. a description of the theory of the methodology in sufficient detail and clarity to allow understanding of the methodology and independent duplication of results.

   b. a description of the area(s) of applicability which 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, *"Nuclear Criticality Safety in*

Operations With Fissionable Material Outside Reactors," any extrapolation beyond the area(s) of applicability should be supported by an established mathematical methodology.

c. a description of pertinent computer software and hardware that is used in the methodology, including codes, assumptions, and techniques

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

e. a description of the data used in the methodology consistent with reliable experimental measurements.

f. a description of the benchmark experiments that cover the intended ranges of applicability and data derived therefrom that can be 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 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 1.0 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 1.0). [Comment: clarification of what is meant by "…*uncertainty in the data*…" should be provided.]

h. a description of the bounding assumptions for the methodology

i. a description of the verification process and results.

3. The applicant commits to use each NCS methodology in accordance with the following principles:

a. each NCS methodology shall only be used in the area(s) of applicability specified in the facility NCS reference manual or validation report. Use in other area(s) of applicability requires written approval from the NCS program director and demonstration that trends in the bias support extension of the NCS methodology outside the area(s) of applicability.

b. mathematical relations shall only be used within the context of their fundamental assumptions and limitations

c. data shall be used consistently with reliable experimental measurements.

d plant specific benchmark experiments and data derived therefrom shall be used to validate the methodology.

e. 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 shall be established for each application of an NCS methodology.

f. appropriate software and hardware shall be used for each application of an NCS methodology.

g. the analytical, deterministic or statistical method(s) used to calculate k-eff shall be specified

4. The applicant commits to performing NCS determinations in accordance with the following principles:

a. NCS safety and NCS operating limits for items relied on for safety (controlled parameters) are 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 limit the controlled parameter to a certain range of values.

b. NCS safety limits are derived from either: (i) experimental data published in applicable ANSI standards or in industry-accepted handbooks, or (ii) using validated analytical methods

c. NCS safety limits shall be based upon application of the NCS methodology appropriate to the process under study.

d. NCS operating limits are derived from NCS safety limits by taking into consideration changes in operating parameters (e.g. changes in SNM mass, reflection, moderator mass, neutron interaction, etc.) to ensure processes will remain subcritical under both normal and credible abnormal conditions

e. NCS safety and operating limits establish sufficient margins of safety for processes and take into consideration the variability and uncertainty in a process and the NCS subcritical limit

f. The margin of subcriticality for a process operation shall be large compared to the calculated value of k-eff

g. 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. The applicant provides a summary of its commitments to prepare and maintain NCS methodologies that includes as a minimum the following:

a. concise summary of each NCS methodology used in performing NCS determinations

b. computer software, assumptions and techniques used

c. data used in each application of the NCS methodology (including any benchmark experiments)

d. validations of the NCS methodology and any verification results

e. bias, uncertainty in the bias, uncertainty in the NCS methodology and data, established margin of subcriticality and bases for these items for the selected NCS methodology

~~2.~~ [Comment: paragraph (2) requires the applicant to commit to the '*intent*' of Reg. Guide 3.71 – an impossible task. If the intent of a Reg. Guide is important enough to require a commitment from an applicant, the NRC should revise it to incorporate the statement of the intent of the Reg. Guide to which all applicants will be held accountable. If the Reg. Guide is, however, too onerous to expect an applicant to commit verbatim, it should be revised to reduce the requirements to the level that is reasonable for applicants to commit to. This paragraph 2 have been incorporated elsewhere in this §5.4.3.3.1.] ~~The applicant commits to the intent of the requirement in Regulatory Guide 3.71, *"Nuclear Criticality Safety Standards for Fuels and Materials Facilities"* related to validation reports which is: The applicant should demonstrate: (1) the adequacy of the Margin of Subcriticality for Safety 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(s) of Applicability.~~

~~3.~~ [Comment: this section requires listing in a reference manual all NCS methods and criticality safety reference sources that the licensee will ever use. Updating computer programs, critical mass information or references will, therefore, require a license amendment and NRC approval. Use of new reference materials, NCS data or computer programs should not require a license amendment. This section must be revised to allow upgrading of tools available to an NCS engineer without the necessity of applying for a license amendment.] ~~The applicant includes a reference to (including date and revision number)~~ [Comment: inclusion of a date and revision number implies the licensee must obtain NRC review and approval when the version is updated. This would be an undue burden with no benefit to safety. Delete the parenthetical.] ~~and summary description of either a manual or a documented, reviewed, and approved validation report (by NCS and Management) for each methodology which will be used to make an~~ [Comment: estimate of k-eff]~~NCS determination (e.g., experimental data, reference books, hand calculations, deterministic computer codes, probabilistic computer codes).~~[Comment: strict adherence to this requirement is impractical as '*NCS determinations*' could include a very broad set of engineering calculations such as thermodynamics, heat transfer, general physics, nuclear kinetics, etc. The QA programmatic process of independent technical reviews will ensure that valid techniques are utilized (with the exception of validation of k-eff code calculations, which require validation). Thus, NEI recommends that "…*NCS determinations*…" be replaced to read "…*estimate of k-eff*…"] ~~The summary description of the reference manual or validation report should have:~~

~~a. a summary of the theory of the methodology in sufficient detail, clarity, and lack of ambiguity that allows understanding of the methodology.~~

~~b. a commitment to apply the methodology only in the Area(s) of Applicability or provide justifications for applying the methodology outside the Area(s) of Applicability.~~

~~c. a commitment to use pertinent computer codes, assumptions, and techniques in the methodology.~~

~~d.~~ [Comment: the phrase "…*proper functioning of mathematical operations*…" is very vague and its meaning is unclear. NEI recommends that the following text revision.] ~~a commitment to use proper functioning of the mathematical~~ relations only within the context of their fundamental assumptions and limitations~~operations in the methodology.~~

e. a commitment to use the data consistently with reliable experimental measurements.

f. a commitment to use plant specific benchmark experiments and data derived therefrom that will be used to validate the methodology.

g. a commitment to determine 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, when using the methodology. [Comment: clarification of what is meant by "…*uncertainty in the data*…" should be provided.]

h. a commitment to use appropriate controlled software and hardware when using the methodology. [Comment: the phrase "…*controlled software and hardware*…" should be clarified. Would not reference to appropriate consensus standards be more suitable?}

5i. a commitment to The applicant commits to provide information to validate the analytical, deterministic or statistical method(s) used to calculate k-eff.use a verification process when using the methodology. [Comment: the term "verification process" is unclear. How does one "verify" experimental data or handbooks that are included explicitly in the applicability of this section? Clarify this section with the recommended text changes.]

4. The applicant commits to have, at the facility, the reference manual or documented, reviewed, and approved validation report (by NCS 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 in sufficient detail, clarity, and lack of ambiguity that allows understanding of the methodology and independent duplication of results.

b. a description of the Area(s) of Applicability which 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, *"Nuclear Criticality Safety in Operations With Fissionable Material Outside Reactors,"* any extrapolation beyond the Area(s) 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., mathematical testing).

e. a description of the data used in the methodology consistent with reliable experimental measurements.

f. [Comment: the meaning of the term "…*plant specific benchmark experiments*…" could be clarified. NEI recommends clarifying this language to read as noted below.] a description of the plant specific benchmark experiments and 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 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 1.0 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 1.0). [Comment: clarification of what is meant by "…*uncertainty in the data*…" should be provided.]

h. a description of the software and hardware that will use the methodology.

i. a description of the verification process and results.

5. The applicant commits to incorporate each reference manual or documented, reviewed, and approved validation report (by NCS and Management) for a methodology as well as assumptions used into the facility Configuration Management program.[Comment: the meaning of the phrase "…*incorporate each reference manual…or validation report…into the facility Configuration management program*…" We assume that means the documents are to be controlled, whether they are part of the CM program or not.]

6. The applicant commits to performing NCS determinations using specified methods. The applicant should commit to incorporating these methods into the facility Management Measures:

a. The applicant should commit to assuming credible optimum conditions (i.e., most reactive conditions physically possible or limited by written commitments to regulatory agencies) for each Controlled Parameter unless specified controls are implemented to limit the Controlled Parameter to a certain range of values.

b. [Comment: the definition of "…*NCS operating and safety limits*…" and the meaning of the associated modifiers are not clear. NEI recommends this clause be clarified as follows: The applicant commits to set NCS limits based upon specified methods].The applicant should commit to set NCS operating and safety limits derived from experimental data, reference books, hand calculations, deterministic computer codes, or probabilistic computer codes which have either a reference manual or a documented, reviewed, and approved validation report (by NCS and Management).

c. The applicant should commit to consider the variability and uncertainty in a process and the NCS subcritical limit when setting NCS safety limits.

d. The applicant should commit to consider the variability and uncertainty in a process and the NCS safety limit when setting NCS operating limits.

5.4.3.3.2 NCS Technical Practices~~5.4.3.3.2Technical Practices~~

~~To provide for NCS, the~~ The applicant's commitment to identify and use appropriate NCS ~~T~~technical p~~P~~ractices should be considered acceptable if it fulfills the following criteria ~~the applicant has met the following Acceptance Criteria or has identified and justified an alternative in the application~~: [Comment: a minor point, but NEI recommends that terms not defined in the Glossary not be capitalized.]

~~1.~~ [Comment: contrary to the assertion in this Item (1), a physical design feature or item ***can*** provide two separate and independent safety functions. For instance, an overpack could conceivably provide spacing and geometry control. These functions could be independent and separately unlikely to fail; therefore, they could satisfy double contingency. NEI recommends that Item (1) be deleted, or at least clarified to allow for this interpretation of NCS control. Item 1 is a statement of practice rather than an acceptance criterion.] ~~Although the applicant may use a single NCS control to maintain the values of two or more Controlled Parameters, this use constitutes only one component necessary for Double Contingency Protection.~~

1~~2~~. Based on the Performance Requirements in 10 CFR 70.61(d), the applicant commits to the policy that: "No single credible event or failure could result in a nuclear criticality accident."

2~~3~~. The applicant commits to the preferred use of Passive-Engineered controls to ensure NCS. The applicant should commit to the following preference, in general, for controls to ensure NCS: (1) Passive-Engineered, (2) Active-Engineered, (3) Augmented-Administrative, and (4) Simple-Administrative. ~~When choosing not to use a Passive-Engineered control, the applicant commits to identify and provide justification in the ISA.~~ [Comment: The SRP should not require an applicant to justify why some practice or approach was not used. It is only necessary for the applicant to demonstrate that double contingency protection has been implemented with the items relied on for safety (or control systems) that the applicant has selected. The second sentence should be deleted.]

~~4.~~ [Comment: Heterogeneity is just one parameter among many that affect reactivity. If heterogeneity results in the most reactive condition and it is ignored, then the licensee has failed to meet the requirement of §5.4.3.3.1.4(a) which specifies that analysis of "optimum" conditions is required. Item (4) is redundant and should be deleted.] ~~When evaluating a Controlled Parameter, heterogeneous effects are considered. Heterogeneous effects are particularly relevant for low-enriched uranium processes, where, when all other parameters are equal, heterogeneous systems are more reactive than homogeneous systems.~~

3~~5~~. The applicant commits to designate ~~incorporate~~ c~~C~~ontrolled p~~P~~arameters used in NCS as items relied on for safety and to apply ~~into the facility~~ Management Measures to them~~of 10 CFR 70.62.~~ Controlled parameters available for NCS control include: mass, geometry, density, enrichment, reflection, moderation, concentration, interaction, neutron absorber and volume.

~~6. 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.~~ [Comment: this was performed in the ISA. Delete.]

~~7. The applicant commits to describe Controlled Parameters used as NCS control. Examples of Controlled Parameters available for NCS control are: Mass, Geometry, Density, Enrichment, Reflection, Moderation, Concentration, Interaction, Neutron Absorber, and Volume.~~ [Comment: included in Item(3) above.]

4~~8~~. the applicant commits to measure ~~When~~ c~~C~~ontrolled p~~P~~arameters ~~are controlled for safety reasons by measurement,~~ using reliable methods and instruments that are sufficiently sensitive and calibrated and maintained in accordance with the manufacturer's specifications. ~~should be used~~. It is acceptable if the applicant commits to representative sampling, reliable

measurement instruments and methods, and dual independent measurements where there is significant susceptibility to human error.

5. NCS controlled parameters and techniques for controlling them are established based on the results of the ISA. Acceptable conditions for the use of the following NCS controls are specified below:

i. ~~9~~. The use of m~~M~~ass as a criticality ~~C~~controlled ~~P~~parameter should be considered acceptable if:

a. NCS safety limits for the controlled parameter (mass) are established based upon experimental data or validated analytical methods.

b~~a~~. ~~When a given Mass of material has been determined, a~~ A percentage factor is used to determine the ~~Mass~~ percentage of SNM in a given mass of material. ~~in that material.~~

c~~b~~. ~~When~~ F~~f~~ixed geometric devices are used to limit ~~the Mass of~~ SNM using~~,~~ a conservative process density ~~is used~~.

d~~c~~. ~~When p~~Physical measurement of ~~the~~ Mass is ~~needed, the measurement is~~ obtained by ~~using~~ instrumentation.

e~~d~~. When double batching of SNM is possible, the m~~M~~ass of SNM is limited to no more than 45% of the minimum critical Mass based on spherical geometry. [Comment: This rule of thumb for acceptable mass limits has historically been applied to criticality data or handbook values and apply only to single parameter limits. Mass limits derived by other means (e.g. computer code calculations) do not necessarily need these margins applied to obtain safe operating limits. This requirement should be clarified.]

f~~e~~. When double batching of SNM is not possible, the m~~M~~ass of SNM is limited to no more than 75% of the critical Mass. [Comment: This rule of thumb for acceptable mass limits has historically been applied to criticality data or handbook values and apply only to single parameter limits. Mass limits derived by other means (e.g. computer code calculations) do not necessarily need these margins applied to obtain safe operating limits. This requirement should be clarified.]

ii~~10.~~ The use of g~~G~~eometry as a criticality ~~C~~controlled ~~P~~parameter should be considered acceptable if:

a. NCS safety limits for the controlled parameter (geometry) are established based upon experimental data or validated analytical methods.

b. an evaluation is performed demonstrating that geometry will be maintained under both normal operating conditions and credible abnormal conditions.

c~~a~~. ~~Before beginning operations, all~~ All dimensions and nuclear properties relied upon for geometry control are verified before commencing operations and controls are exercised to maintain these dimensions and nuclear properties. ~~which use Geometry control are~~

verified. The facility Configuration Management program should be used to maintain these dimensions and nuclear properties.

db. When using large single units, the Margins of Safety are 90% of the minimum critical cylinder diameter, 85% of the minimum critical slab thickness, and 75% of the minimum critical sphere volume. [Comment: These rules of thumb for acceptable geometry limits have historically been applied to criticality data or handbook values and apply only to single parameter limits. Geometry limits derived by other means (e.g. computer code calculations) do not necessarily need these margins applied to obtain safe operating limits. This requirement should be clarified.]

iii11. The use of dDensity as a criticality Ccontrolled Pparameter should be considered acceptable if:

a. NCS safety limits for the controlled parameter (density) are established based upon experimental data or validated analytical methods.

ba. When Process Variables can may affect the Density, the Process Variables are identified as items relied on for safety (IROFS) in the ISA Summary.

cb. PWhen physical measurement of the Ddensity is needed, the measurement is obtained by using instrumentation.

iv12. The use of eEnrichment as a criticality cControlled Pparameter should be considered acceptable if:

a. NCS safety limits for the controlled parameter (enrichment) are established based upon experimental data or validated analytical methods.

ba. A method of segregating enrichments is used to ensure differing enrichments will be not interchanged, or else the most limiting enrichment is applied to all material. When using SNM with differing Enrichment, the SNM is segregated by Enrichment .

cb. PWhen physical measurement of the eEnrichment is needed, the measurement is obtained by using instrumentation.

v13. The use of Rreflection as a criticality cControlled pParameter should be considered acceptable if:

a. An appropriate safety margin is established in accordance with the acceptance criteria for NCS limits

b~~a.~~ When investigating an individual unit, the wall thickness of the unit and all reflecting adjacent materials of the unit are considered. [Comment: the second sentence (below) should be deleted as methodologies of §5.4.3.3.1 might be able to show that different distances to reflection materials are safe and therefore the requirement for one-foot separation is arbitrary and not needed.]~~The adjacent materials should be farther than one foot away from the unit.~~ [Comment: the SRP may want to mention that operators typically claim partial reflection as a bounding assumption rather than a controlled parameter. In this case, one does not need to establish controls that have to be maintained.]

c~~b~~. P~~After identifying p~~otential reflectors (other than the unit wall and adjacent materials specified in (b) above) are identified and suitable items relied on for safety (engineered and/or administrative ~~, the~~ controls) ~~to prevent the presence of the potential reflectors~~ are established to exclude them. ~~identified as IROFS in the ISA Summary.~~

vi~~1~~4. The use of m~~M~~oderation as a criticality c~~C~~ontrolled p~~P~~arameter should be considered acceptable if: [Comment: there are inaccuracies in the technical language in this section. "Moderation" is technically not measured (part c), or sampled (part e) or does not '…*ingress*…' (parts d & g), but rather the *moderator* (mass or concentration) is measured or sampled, not the moderation that is taking place.]

a. An appropriate safety margin is established in accordance with the acceptance criteria for NCS limits

b~~a~~. The applicant commits to use moderation consistent with the guidance provided~~When using Moderation, the applicant commits to the requirements~~ in ANSI/ANS-8.22-1997, *"Nuclear Criticality Safety Based on Limiting and Controlling Moderators."*

c~~b~~. Process variables that may affect moderation ~~When Process Variables can affect the Moderation, the Process Variables~~ are identified as IROFS~~ in the ISA Summary.~~

d~~c~~. P~~When p~~hysical measurement of the Moderation, either as ~~is needed,~~ the mass or concentration of the moderator, ~~measurement~~ is obtained by ~~using~~ ~~i~~instrumentation.

e~~d~~. ~~When designing P~~physical structures are designed to ~~, the design~~ precludes the ingress of moderators ~~Moderation~~.

f~~e~~. ~~When s~~Sampling of the moderator ~~Moderation~~ is conducted ~~needed, the sampling program uses dual independent~~ using appropriate sampling methods. [Comment: the '…*dual*…" sampling requirement is redundant with the wording in §5.4.3.3.2 (8) for the use of instrumentation and is not needed. Sampling is no more important for moderation than it would be for enrichment, concentration, density or any other parameter where instrumentation is used for measurements. Modify this sentence as shown.]

g~~f~~. Restrictions on the use of hydrogenous materials for fire fighting activities are established in moderation control areas.~~When developing firefighting procedures for use in a Moderation controlled area, restrictions are placed on the use of Moderator material.~~

hg. All credible sources of moderating materials are examined to evaluate the potential for intrusion into the moderation control area and are either precluded or appropriately controlled.~~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.~~

vii15. The use of Cconcentration as a criticality Ccontrolled Pparameter should be considered acceptable if:

a. An appropriate safety margin is established in accordance with the acceptance criteria for NCS limits

ba. ~~When~~ Process Vvariables that may ~~can~~ affect SNM solubility are evaluated and designated as items relied on for safety.~~the Concentration, the Process Variables are identified as IROFS in the ISA Summary~~.

b. ~~High Concentrations of SNM in a process are precluded.~~ [Comment: the statement precluding high concentrations is arbitrary and without apparent basis. If the NCS analysis demonstrates safety for a range of concentrations, including "high" concentrations, but requires reliable controls for "higher" concentrations, then the safety basis for the operation is adequate. Delete this clause.]

c. Tanks ~~When using a tank~~ containing Cconcentration controlled solution remain~~, the tank is~~ normally closed.

d. ~~When sampling of the Concentration is needed, the sampling program uses dual independent sampling methods~~. [Comment: the '…*dual*…" sampling requirement is redundant with the wording in §5.4.3.3.2 (8) for the use of instrumentation and is not needed. Sampling is no more important for concentration than it would be for enrichment, moderation, density or any other parameter where instrumentation is used for measurements. Revise this clause as follows.] Sampling programs to measure concentration use appropriate sampling methods.

e. ~~After identifying p~~Possible precipitating agents are identified to the operators and appropriate ~~,~~ precautions are taken to ensure that such agents will not be inadvertently introduced.

viii16. The use of iInteraction as a criticality cControlled pParameter should be considered acceptable if:

aa. [Comment: the statement in this paragraph does not allow for control other than by passive engineered means, regardless of the results of the ISA. This statement must be corrected.] The ~~When maintaining a~~ physical separation between units is evaluated and controlled using by methods evaluated in the ISA including ~~,~~ engineered devices (e.g.~~i.e.~~, spacers, racks) ~~with a minimum spacing~~ or augmented administrative spacing (e.g. visible markers with appropriate spacing). ~~are used. The structural integrity of the spacers should be sufficient for normal and credible abnormal conditions.~~

ix17. The use of a Nneutron Aabsorber as a criticality Ccontrolled Pparameter should be considered acceptable if: [Comment: this section should mention soluble poisons as a neutron absorber.]

a. NCS safety limits for the controlled parameter (neutron absorption) are established based upon experimental data or validated analytical methods.

b~~a~~. The requirements of ~~When using Borosilicate-Glass Raschig Rings, the applicant commits to the requirements in~~ ANSI/ANS-8.5-1996, *"Use of Borosilicate-Glass Raschig Rings as a Neutron Absorber in Solutions of Fissile Material~~:~~"* are fulfilled when using borosilicate-glass Raschig rings.

c~~b~~. The requirements of ~~When using Fixed Neutron Absorbers, the applicant commits to the requirements in~~ ANSI/ANS-8.21-1995, *"Use of Fixed Neutron Absorbers in Nuclear Facilities Outside Reactors"* are fulfilled when using fixed neutron absorbers

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

x~~18~~. The use of ~~V~~volume as a criticality ~~C~~controlled p~~P~~arameter should be considered acceptable if:

a. NCS safety limits for the controlled parameter (volume) are established based upon experimental data or validated analytical methods.

b. ~~When using Volume control, g~~Geometrical devices are used to restrict the ~~V~~volume of SNM. E~~e~~ngineered devices or instrumentation limit the accumulation of SNM

c~~b~~. P~~When p~~hysical measurement of ~~the V~~volume are made by ~~is needed, the measurement is obtained by using~~ either instrumentation or a calibrated volume device. [Comment: volume measurements can be obtained by various methods, including, but not limited to, instrumentation.].

5.4.3.3.3 Criticality Accident Alarm System ~~Requirements of 10 CFR 70.24 (CAAS)~~

~~5.4.3.3.3Requirements of 10 CFR 70.24 (CAAS)~~

The applicant's commitment to install and maintain a CAAS should be considered acceptable if it fulfills the following criteria: ~~To provide for NCS, the applicant's commitment to the CAAS requirements in 10 CFR 70.24 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 commits to design and install a CAAS in areas identified in the ISA having potential nuclear criticality hazards that will reliably detect excessive radiation dose rates and signal audible alarms for conditions that require personnel evacuation. The CAAS must adequately and reliably detect an individual inadvertent nuclear criticality at the points where criticality monitoring instrumentation is placed. ~~of has documented that the facility CAAS meets the requirements of 10 CFR 70.24.~~

2. The applicant commits to design, install and maintain a CAAS consistent with the guidance contained ~~the requirements~~ in ANSI/ANS-8.3-1997, *"Criticality Accident Alarm System~~:~~"* and 10 CFR 70.24.

3. The applicant commits to the requirements in Regulatory Guide 3.71, *"Nuclear Criticality Safety Standards for Fuels and Materials Facilities"* which pertain to ~~effect~~ the ANSI/ANS-8.3 standard:

   a. The applicant commits to criticality alarm system coverage for all processes and activities (e.g. processing, storage, handling) that the ISA identifies as potential nuclear criticality hazards ~~At or above the 10 CFR 70.24 mass limits, CAAS coverage shall be required in each area in which SNM is handled, stored, or used.~~ [Comment: the locations of CAAS coverage should be dictated by the results of the ISA.]

   b. ~~10 CFR 70.24 requires that~~ In contrast to the criterion in ANSI/ANS-8.3 requiring coverage by only one detector, two detectors shall be required for coverage of all areas.~~each area that needs CAAS coverage to be covered by two detectors.~~

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

~~4~~ 4. The applicant commits to design and install~~having~~ a CAAS that:

   (a) meets the design criteria of ANSI/ANS-8.3

   ~~(b) that~~ is uniform throughout the facility for the type of radiation detected, the mode of detection, the alarm signal, and the system dependability.–

   ~~(c) 5. 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.

   ~~(d) 6. The applicant commits to having a CAAS that is designed to~~ remains operational in case of ~~during credible events such as a~~ fire, ~~an~~ explosion, ~~a~~ corrosive atmosphere or other extreme conditions~~, and other credible conditions.~~

   ~~(e) 7. 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.~~

~~5~~8. 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 supposedly make them safe, carries a certain real risk while, on the other hand, being without a criticality alarm for a while is clearly a comparatively small risk.~~may carry a larger risk, than being without a CAAS for a short time.~~ The applicant should commit to compensatory measures (e.g., limit access, halt SNM movement) when the CAAS system is not functioning due to Maintenance.

~~6~~9. Emergency plans are maintained where alarm systems are installed and in accordance with the following:~~Management (information related to these Acceptance Criteria may be consolidated with other emergency management descriptions elsewhere in the application in response to Chapter 8.0):~~

   a. The applicant commits to undertake emergency planning consistent with the guidance provided ~~the requirements~~ in ANSI/ANS-8.23-1997, *"Nuclear Criticality Accident Emergency Planning and Response."*

b. The applicant either has an Emergency Plan or satisfies the alternate requirements found in 70.22.(h)(1)(i).

c. [Comment: this Item (c) requires that a licensee provide personnel accident dosimeters in areas that require CAAS and a method for prompt on-site dosimeter readouts. A reviewer could conclude that all personnel who enter an area covered by a CAAS are required to have both gamma- and neutron-sensitive dosimeters in addition to accident dosimeters located throughout the facility along with a mechanism to read such dosimeters on site. This is not current industry practice. In the event of a nuclear criticality, having the ability to read TLDs on site would be of little benefit because personnel will be evacuated from the area and will not be allowed to return until the accident has terminated and little risk of recurrence has been determined. What is only required is a method of quickly determining which personnel may need urgent medical attention and an assurance that emergency response personnel will be provided with dosimeters so that any radiation exposure to them is tracked.] The applicant commits to provide fixed and personnel accident dosimeters in areas that require a CAAS~~, as well as a method for prompt onsite dosimeter readouts~~. These dosimeters should be readily available to personnel responding to an emergency.

~~d.~~ [Comment: as noted earlier, the wording of this requirement for emergency power for the CAAS should be the same as that found in the applicable standard (ANSI/ANS-8.3-1997) and the SRP should consider compliance with this ANSI standard to be sufficient. As this commitment has been made above (§5.4.3.3.3(2), item (d) is redundant and should be deleted.]~~The applicant commits to provide emergency power for the CAAS.~~

5.4.3.3.4 ~~Requirements of 10 CFR 70.61 (~~Subcriticality of Operations and Margin of Subcriticality for Safety~~)~~5.4.3.3.4Requirements of 10 CFR 70.61 (Subcriticality of Operations and Margin of Subcriticality for Safety)

The applicant's commitment to ensure that all nuclear processes are maintained subcritical and operated with an acceptable margin of subcriticality should be considered acceptable if it fulfills the following criteria:~~To provide for NCS, the applicant's commitment to the Subcriticality of Operations and Margin of Safety for Subcriticality requirements in 10 CFR 70.61 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 commits to the use of NCS controls and items relied on for safety (c~~C~~ontrolled p~~P~~arameters) to ensure both s~~S~~ubcriticality of o~~O~~perations and ~~M~~margin of s~~S~~ubcriticality for s~~S~~afety. As required by ANSI/ANS-8.1-1983, *"Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors,"* process specifications shall incorporate margins to protect against uncertainties in process variables and against a limit being accidentally exceeded."

2. The applicant commits to maintain nuclear processes subcritical with an acceptable margin of subcriticality consistent with the guidance provided in:

   ~~(i) the requirements in~~ ANSI/ANS-8.7-1975, *"Guide for Nuclear Criticality Safety in the Storage of Fissile Materials."*

~~(ii) 3. The applicant commits to the requirements in~~ ANSI/ANS-8.9-1987, *"Nuclear Criticality Safety Criteria for Steel-Pipe Intersections Containing Aqueous Solutions of Fissile Materials."*

~~(iii) 4. The applicant commits to the requirements in~~ ANSI/ANS-8.10-1983, *"Criteria for Nuclear Criticality Safety Controls in Operations With Shielding and Confinement."*

~~(iv) 5. The applicant commits to the requirements in~~ ANSI/ANS-8.12-1987, *"Nuclear Criticality Control and Safety of Plutonium-Uranium Fuel Mixtures Outside Reactors."*

~~(v) 6. The applicant commits to the requirements in~~ ANSI/ANS-8.15-1981, *"Nuclear Criticality Control of Special Actinide Elements."*

~~(vi) 7. The applicant commits to the requirements in~~ ANSI/ANS-8.17-1984, *"Criticality Safety Criteria for the Handling, Storage, and Transportation of LWR Fuel Outside Reactors."*

3~~8~~. [Comment: this provision is not acceptable and should remain only if administrative margin is used in lieu of the methodologies described in §5.4.3.3.1. An administrative margin may, typically, be used in addition to one of the NCS methodologies.] 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.

4~~9~~. The applicant commits to the use of ~~controls or control barriers on~~ items relied on for safety identified in the ISA ~~IROFS~~ to ensure that an inadvertent nuclear criticality will not occur.

5~~10~~. The applicant commits to apply management measures to ensure that items relied on for safety are reliable and available when needed.~~incorporating controls and control barriers into the facility Management Measures of 10 CFR 70.62.~~

6~~11~~. The applicant commits to determining subcritical limits for k-eff calculations such that : k-subcritical = 1.0 - bias-margin, where margin includes adequate allowance for uncertainty in the methodology, experimental data, and bias to assure subcriticality.

~~12.~~ [Comment: this Item 12 appears to require the applicant to make an open-ended commitment to performing multiparameter sensitivity analysis. This requirement appears to go far beyond proven industry practices without yielding a clear benefit to safety. NEI recommends that this Item 12 be deleted. Otherwise, the bounds on this commitment must be clarified and the direct application of the results to safety be specified.]~~The applicant commits to performing studies to correlate the change in 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.~~

~~13. The applicant meets the Acceptance Criteria in Section 3.4.1 (ISA Summary) as they relate to Subcriticality of Operations and Margin of Subcriticality for Safety.~~ [Comment: the acceptance criteria for the ISA Summary address only what information distilled from the ISA is to be included. There are no '*acceptance criteria*' for NCS in SRP Chapter 3.]

Comment: the following note is not needed. '*Acceptance criteria*' for accident sequences having potential for a nuclear criticality hazard are pertinent for review of the ISA, but not for the review of the NCS program. The ISA will have identified items relied on for safety and management measures to ensure that a nuclear criticality is a low risk event. The text should

be deleted..]*Note: This is the Acceptance Criteria to review the High-Risk Accident Sequences and a cross-section of Low-Risk Accident Sequences.*

5.4.3.3.5 Requirements of 10 CFR 70.64 (BDC)5.4.3.3.5Requirements of 10 CFR 70.64 (BDC) [for new facilities and processes only]

To provide for NCS, the applicant's commitment to the BDC requirements in 10 CFR 70.64 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 commits to the Double Contingency Principle in determining NCS controls in the design of new facilities or new processes at existing facilities.

5.4.3.3.6 Requirements of 10 CFR 70.65 (ISA Summary)5.4.3.3.6Requirements of 10 CFR 70.65 (ISA Summary)

[Comment: this entire §5.4.3.3.6 is not required in SRP Chapter 5. NCS accident sequences were reviewed in the ISA Summary as a Chapter 3 task; conformance with the performance requirements of 10 CFR 70.61 (b) and (c) was previously evaluated and confirmed. The 10 CFR 70.61(d) requirement to ensure subcriticality and to operate with an acceptable margin of safety have been addressed in §5.4.3.3.4 above.

The applicant is required to meet the performance criteria in 10 CFR 70.61(b) and (c) as well as the performance requirements in 70.61(d), which include the requirement to limit the risk of an inadvertent nuclear criticality by assuring that all nuclear processes remain subcritical. The applicant's evaluation of NCS Accident Sequences should be performed in a manner consistent with the applicant's evaluation of non-NCS Accident Sequences used to meet 10 CFR 70.61(b) and (c); however 10 CFR 70.61(d) requires the applicant to use prevention methods as the primary means to meet the performance requirements of 10 CFR 70.61(b) and (c).

To provide for NCS, the applicant's commitment to the ISA requirements in 10 CFR 70.65 should be considered acceptable if the applicant has met the following Acceptance Criteria or has identified and justified an alternative in the application:

1. Accident Sequences:

   a. The applicant meets the Acceptance Criteria in Section 3.4.1 (ISA Summary) related to Accident Sequences for NCS.

   b. The applicant commits to use Appendix A of ANSI/ANS-8.1-1983, *"Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors"* in determining Accident Sequences.

2. Consequences:

   a. The applicant meets the Acceptance Criteria in Section 3.4.1 (ISA Summary) related to Consequences for NCS.

   b. The applicant commits to the requirements in ANSI/ANS-8.10-1983, *"Criteria for Nuclear Criticality Safety Controls in Operations With Shielding and Confinement."* In addition,

the applicant should commit to the requirements in RG 3.71, *"Nuclear Criticality Safety Standards for Fuels and Materials Facilities"* which effect the ANSI/ANS 8.10 standard.

3. Likelihoods:

a. The applicant meets the Acceptance Criteria in Section 3.4.1 (ISA Summary) related to Likelihoods for NCS.

b. The applicant commits to implement an NCS program that ensures Double Contingency Protection when practicable. When evaluating Double Contingency Protection, the term "unlikely" should be used in a manner consistent with ANSI/ANS-8.1-1983.

1. Adherence to Double Contingency Protection: Each process which could have an inadvertent nuclear criticality should have Double Contingency Protection. Double Contingency Protection may be provided by either (a) At Least Two Parameter Control: the control of at least two independent process parameters or (b) Single Parameter Control: a system of multiple independent controls on a single process parameter. The At Least Two Parameter Control method is the preferred approach due to the difficulty of preventing common-mode failure when controlling only one parameter.

2. As used in Double Contingency Protection, 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 rendered safe. If not, processes can remain vulnerable to a second failure for extended periods of time.

3. If the applicant adheres to Double Contingency Protection for an NCS Accident Sequence, then the Likelihood requirements of 10 CFR 70.61(b) should be considered satisfied for that Accident Sequence.

4. Exceptions to 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 and provide justification in the ISA for exceptions to Double Contingency Protection.

4. Risk:

a. The applicant meets the Acceptance Criteria in Section 3.4.1 (ISA Summary) related to Risks for NCS.

5. IROFS:

a. The applicant meets the Acceptance Criteria in Section 3.4.1 (ISA Summary) related to IROFS for NCS

5.4.3.3.5 Additional NCS Program Commitments

The applicant's additional commitments regarding the NCS program should be considered acceptable if they fulfill the following criteria:

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 program any unacceptable performance deficiencies in an item relied on for safety, NCS system or management measure so as to prevent recurrence.

2. For the design of new facilities or new processes at existing facilities that require a license amendment under 10 CFR 70.72, the applicant commits to adhere to the baseline design criteria of 10 CFR 70.64, including adherence to the double contingency principle.

3. The applicant commits to support the facility change mechanism process by performing NCS determinations, when needed, to evaluate within the facility's ISA, changes to processes, operating procedures, items relied on for safety or management measures.

4. The applicant commits to upgrade the NCS program, as appropriate, to reflect changes in the ISA or new NCS methodologies, and to recommend modifications to operating and maintenance procedures that could reduce the likelihood of occurrence of an inadvertent nuclear criticality

5. The applicant commits to implement an NCS program that ensures double contingency protection when practicable

6. The applicant commits to retain records of NCS programs and to document any corrective actions taken

7. The applicant commits to use the NCS methodologies and technical practices outlined in sections 5.3.3 of this SRP chapter to evaluate NCS accident sequences in plant operations and processes.

5.5 REVIEW PROCEDURES 5.5REVIEW PROCEDURES

[Comment: Proposed revisions to this section 5.5 are mainly stylistic and are designed to ensure consistency amongst all of the SRP chapters.]

~~The reviewer should use the Regulatory Guidance of this chapter; references in this chapter; the applicant's 91-01, 70.50, and 70.74 reports; and 10 CFR Part 70 Appendix A reporting requirements.~~[Comment: this sentence offers little assistance to the reviewer. It is the contents of this SRP Chapter 5 that the reviewer will use in performing the license application approval. (Note that 91-01 reports have been done away with by changes in 10 CFR 70.74.) The sentence is redundant and should be deleted.]

5.5.1 Acceptance Review 5.5.1Acceptance Review

The Primary Reviewer should evaluate ~~review~~ the application to determine whether it addresses the "Areas of Review" ~~applicant's NCS information for completeness with respect to the requirements in 10 CFR 70.22, 70.24, 70.61, 70.62, 70.65 and the Acceptance Criteria~~ in

Section 5.4. ~~Using guidance in the "FCLB Materials Licensing Procedures Manual," if~~ If significant deficiencies are identified, ~~then either~~ the applicant should be requested to submit additional material before ~~prior to~~ the start of the safety evaluation~~or the application should be denied.~~

5.5.2 Safety Evaluation 5.5.2Safety Evaluation

~~When an acceptable application is received from the applicant, the~~ The primary reviewer shall perform a safety evaluation against the Acceptance Criteria in Section 5.4 and may consult~~will conduct a complete review of the application and determine its acceptability, consulting~~ with the supporting reviewers to identify and resolve any issues of concern related to the licensing review. The primary reviewer will prepare a safety evaluation report (SER) for the Licensing Project Manager in support of licensing action. ~~(acting as a secondary or supporting reviewer) should also coordinate with other reviewers concerning NCS regarding the following:~~

1. ~~In support of the primary reviewer for Section 2.0, the NCS reviewer should determine whether the Acceptance Criteria in Section 2.0 have been met as they relate to NCS.~~ [Comment: the adequacy of the applicant's Organization and Administration program (including NCS issues) was evaluated as a Chapter 2 task and need not be repeated as a Chapter 5 task. Delete this requirement.]

2. ~~In support of the primary reviewer for Sections 11.1 through 11.8, the NCS reviewer should determine whether the Acceptance Criteria in Sections 11.1 through 11.8 have been met as they relate to NCS.~~ [Comment: the adequacy of the applicant's Management Measures (including those pertaining to NCS accident sequences) will be evaluated as a Chapter 11 task and need not be repeated as a Chapter 5 task. Delete this requirement.]

3. ~~In support of the primary reviewer for Section 3.0, the NCS reviewer should determine whether the Acceptance Criteria in Chapter 3.0 have been met as they relate to NCS.~~ [Comment: the adequacy of the applicant's ISA Summary (including NCS issues) was evaluated as a Chapter 3 task and need not be repeated as a Chapter 5 task. Delete this requirement.]

4. ~~In support of the primary reviewer for Section 8.0, the NCS reviewer should determine whether the Acceptance Criteria in Section 8.0 have been met as they relate to NCS.~~ [Comment: the adequacy of the applicant's Emergency Response program (including NCS responses) will be evaluated as a Chapter 8 task and need not be repeated as a Chapter 5 task. Delete this requirement.]

~~The primary reviewer should determine whether the Acceptance Criteria in Section 5.4 have been met and should prepare the SER NCS chapter in accordance with Section 5.6.~~

5.6 EVALUATION FINDINGS 5.6EVALUATION FINDINGS

The reviewer will write an SER addressing each topic reviewed and explain why the NRC staff has reasonable assurance that the NCS part of the application is acceptable and that the health and safety of the workers is adequately protected. License conditions may be proposed to impose requirements where the application is deficient. The following kinds of statements and conclusions will be included in the staff's SER: ~~If the staff's review verifies that sufficient information has been provided in the safety program description to satisfy the Acceptance Criteria in Section 5.4, the staff should document its review as follows:~~

The staff has reviewed the Nuclear Criticality Safety (NCS) program for *[name of facility*] according to Chapter 5.0 of the Standard Review Plan. The staff has reasonable assurance that:

1. 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, Administration, and Management Measures.~~

2. The applicant's operational plans~~conduct of operations~~ will be based on NCS engineering and administrative practices ~~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 70.

3. The applicant will develop, implement, and maintain a Criticality Accident Alarm System with corresponding emergency procedures.~~in accordance with the requirements in 10 CFR 70.24 and in accordance with its Emergency Management Program.~~

4. The applicant will have in place an NCS program in accordance with the s~~S~~ubcriticality of o~~O~~perations and m~~M~~argin of s~~S~~ubcriticality for s~~S~~afety requirements in 10 CFR 70.61 and b~~B~~aseline d~~D~~esign c~~C~~riteria requirements in 10 CFR 70.64.

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

~~Note: The Evaluation Finding for the ISA Summary requirements for 10 CFR 70.65 should be in SRP Section 3.6.~~[Comment: redundant clause. Delete.]

5.7 REFERENCES 5.7REFERENCES

[Comment: only the first of the following references is cited in the text of Chapter 5. Should the remaining six references remain in Chapter 5? References 3, 4 and 6 are general NCS references that the reviewer should have available to consult, but NEI recommends that §5.7 --- and more generally, the 'References' section of any SRP chapter --- contain only references that ate specifically cited in the SRP chapter.]

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

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

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

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

DOE/NCT-04, A Review of Criticality Accidents, W. R. Stratton, Revised by D. R. Smith, U.S. Dept. of Energy, March 1989.

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

DOE Order 420.1 (Change 2), *Facility Safety*, October 24, 1996.

PROPOSED REVISION OF SRP (NUREG-1520) CHAPTER 5
INCORPORATING RECOMMENDATIONS
OF THE
NUCLEAR ENERGY INSTITUTE
(AUGUST, 1999)

5.0 NUCLEAR CRITICALITY SAFETY (NCS)

5.1 PURPOSE OF REVIEW 5.1PURPOSE OF REVIEW

The purpose of this review is to determine whether the applicant has made appropriate commitments to develop, implement, and maintain an NCS program in support of safe operation of the facility as required by 10 CFR 70.

Development of the NCS program is based upon the results of the ISA. The NCS program must enable derivation of NCS safety limits and NCS operating limits for facility processes evaluated in the ISA to have nuclear criticality hazards. It must also serve as the mechanism to ensure that items relied on for safety and their associated management measures remain adequate for nuclear processes. Finally, the NCS program must be capable of evaluating NCS implications for facility changes that are evaluated in updates or revisions of the ISA .

The ISA, as summarized in the ISA Summary, was evaluated in SRP Chapter 3 ('*Integrated Safety Analysis (ISA) Commitments and ISA Summary*'). The ISA identified and evaluated the potential risk of accident sequences that could result in conditions leading to an inadvertent nuclear criticality. Nuclear criticality analyses were performed in the ISA to establish NCS safety limits and NCS operating limits and to identify appropriate items relied on for safety to prevent or mitigate such accident sequences. Finally, the ISA recommended management measures to enhance NCS by ensuring the availability and reliability of the items relied on for safety.

The NCS program review entails assessment of the following components:

(i) program objectives
(ii) operational plans, administrative practices and technical criteria to perform NCS studies
(iii) management and organizational structures to execute the program
(iv) procedures to maintain double contingency for NCS (under normal conditions and credible accident conditions)
(v) procedures to maintain a reliable criticality accident alarm system and corresponding emergency procedures
(vi) procedures to control items relied on for safety and management measures for maintenance of NCS.

Prior to evaluating the applicant's NCS program, the reviewer should first consult the ISA Summary (Chapter 3 of the application) to gain familiarity with:

(i) the accident sequences in each area of the plant that could result in an inadvertent nuclear criticality, including the effects of external initiating events
(ii) the specific items relied on for safety (controls or barriers) recommended to provide reasonable assurance that an inadvertent nuclear criticality will not occur, and

(iii) the management measures recommended to ensure the NCS items relied on for safety will operate when required (e.g. receipt of adequate levels of maintenance, training in their operation, etc.)

The reviewer should also consult Chapter 2 of the application ('*Organization and Administration*') to gain familiarity with the applicant's management policies, administrative programs and organizational commitments to support the NCS program.

5.2 RESPONSIBILITY FOR REVIEW5.2RESPONSIBILITY FOR REVIEW

Primary: Nuclear Process Engineer (NCS Reviewer)

Secondary: None

Supporting: Project Manager and Fuel Cycle Inspector (As needed.)

5.3 AREAS OF REVIEW 5.3AREAS OF REVIEW

The staff should review an applicant's NCS program commitments in the following areas:

(i) commitment to develop and implement an NCS program having the following objectives:

- prevention of inadvertent nuclear criticalities
- protection against accident sequences identified in the ISA that could lead to inadvertent nuclear criticalities
- compliance with the NCS performance requirements of 10 CFR 70.61
- establishment of NCS safety parameters and procedures
- establishment and maintenance of adequate NCS safety and NCS operating limits for items relied on for safety
- performance of NCS analyses to ensure all nuclear processes remain subcritical and operate with an acceptable margin of sub-criticality
- provision of continuing assurance that items relied on for safety and management measures are adequate and acceptable
- instruction of plant personnel in NCS and emergency procedures to respond to inadvertent critical excursions
- compliance with NCS Baseline Design Criteria for new processes at existing facilities that require a license amendment under 10 CFR 70.72
- selection of appropriate items relied on for safety and management measures (e.g. training, monitoring, testing, maintenance) based on updated NCS determinations

(ii) commitment to establish an NCS program organization and administrative structure including:

- appointment of staff who are suitably qualified and trained in NCS
- description of the responsibilities and authorities of each key appointment
- provision of sufficient resources to develop, implement and maintain the program

(iii) commitment to identify and use appropriate NCS methodologies and NCS technical practices to conduct NCS analyses of plant operations

(iv) commitment to: (i) audit, assess and upgrade the NCS program, if required, (ii) use the NCS program in revisions of the ISA, and (iii) recommend modifications to plant operating and maintenance procedures to reduce the likelihood of occurrence of an inadvertent nuclear criticality.

(v) commitment to design and install a Criticality Accident Alarm System (CAAS) to provide immediate detection and annunciation of a nuclear criticality

(vi) commitment to refer to the facility's corrective action program any unacceptable performance deficiencies that might (or did) result in an inadvertent nuclear criticality

(vii) commitment to retain records of NCS programs and to document corrective actions taken

Each of the applicant's NCS program commitments will be examined in the Chapter 5 review.

5.4 ACCEPTANCE CRITERIA 5.4ACCEPTANCE CRITERIA

The applicant's NCS program is acceptable if the following acceptance criteria have been met: If an applicant intends to conduct activities where a standard applies and the standard has been endorsed by an NRC Regulatory Guide, then a commitment to comply with all of the requirements (i.e., "shalls") and the appropriate recommendations (i.e., "shoulds") of the standard should constitute an acceptable program under the NRC regulations with respect to the safety aspects addressed by the standard. Any variations from the requirements of the standard should be identified and justified in the application.

Individual commitments to the Acceptance Criteria are expected only when the Acceptance Criteria are relevant to the operations and materials to be licensed.

5.4.1 Regulatory Requirements5.4.1Regulatory Requirements

The regulatory basis for the review should be the general and additional contents of an application as required by 10 CFR 70.22 and 70.65, respectively. In addition, the NCS review should be conducted to ensure compliance with 10 CFR 70.24, 70.61, and 70.62.

5.4.2 Regulatory Guidance5.4.2Regulatory Guidance

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

1. ANSI/ANS-8.1-1983 (Reaffirmed in 1988), *"Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors."*

2. ANSI/ANS-8.3-1997, *"Criticality Accident Alarm System."*

3. ANSI/ANS-8.5-1996, *"Use of Borosilicate-Glass Raschig Rings as a Neutron Absorber in Solutions of Fissile Material."*

4. ANSI/ANS-8.6-1983 (Reaffirmed in 1995), *"Safety in Conducting Subcritical Neutron-Multiplication Measurements In Situ."*

5. ANSI/ANS-8.7-1975 (Reaffirmed in 1987), *"Guide for Nuclear Criticality Safety in the Storage of Fissile Materials."*

6. ANSI/ANS-8.9-1987 (Reaffirmed in 1995), *"Nuclear Criticality Safety Criteria for Steel-Pipe Intersections Containing Aqueous Solutions of Fissile Materials."*

7. ANSI/ANS-8.10-1983 (Reaffirmed in 1988), *"Criteria for Nuclear Criticality Safety Controls in Operations With Shielding and Confinement."*

8. ANSI/ANS-8.12-1987 (Reaffirmed in 1993), *"Nuclear Criticality Control and Safety of Plutonium-Uranium Fuel Mixtures Outside Reactors."*

9. ANSI/ANS-8.15-1981 (Reaffirmed in 1995), *"Nuclear Criticality Control of Special Actinide Elements."*

10. ANSI/ANS-8.17-1984 (Reaffirmed in 1997), *"Criticality Safety Criteria for the Handling, Storage, and Transportation of LWR Fuel Outside Reactors."*

11. ANSI/ANS-8.19-1996, *"Administrative Practices for Nuclear Criticality Safety."*

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

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

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

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

5.4.3 Regulatory Acceptance Criteria5.4.3Regulatory Acceptance Criteria

5.4.3.1 Commitment to NCS Program Implementation

The reviewer will determine that the applicant's NCS program commitment is adequate if it fulfills the following criteria:

(i) the applicant commits to develop, implement and maintain an NCS program to meet the regulatory requirements of 10 CFR 70

(ii) the applicant states the program objectives, which should include the commitment to prevent inadvertent nuclear criticalities, to protect against accident sequences analyzed in the ISA that could result in a nuclear criticality, to maintain plant

operations in a subcritical state and with an acceptable margin of sub-criticality and to maintain compliance with the NCS performance requirements of 10 CFR 70.61

(iii) the applicant establishes NCS safety parameters and procedures

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

(v) the applicant commits to maintain current the facility's NCS methodologies and NCS technical practices by means of the plant's configuration management program

(vi) the applicant commits to use the NCS program to establish and maintain NCS safety and NCS operating limits for items relied on for safety in nuclear processes and to maintain the adequacy of management measures to ensure their availability and reliability (e.g. ensure the maintenance or NCS items relied on for safety, training , inspections and audits to correct deficiencies, evaluation of changes to the NCS program, etc.)

(vii) the applicant commits to preparation of NCS postings and to the training in NCS and emergency procedures of plant personnel working in nuclear processes

(viii) the applicant commits to adhere to applicable NCS baseline design criteria in the design of new processes at existing facilities that require a license amendment under 10 CFR 70.72

(ix) the applicant commits to use the NCS program to evaluate, within the framework of the ISA, any modifications to plant operations, to recommend process parameter changes to maintain the safe operation of the facility and to select appropriate items relied on for safety and management measures

5.4.3.2 Organization and Administration

The reviewer will determine that the applicant's commitment to organize and staff an NCS program is acceptable if it fulfills the following criteria:

(i) The applicant commits to organize and administer the NCS program consistent with the guidance provided in ANSI/ANS-8.1-1983, *"Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors"* and ANSI/ANS-8.19-1996, *"Administrative Practices for Nuclear Criticality Safety."*

(ii) The applicant commits to describe organizational positions, experience and qualifications of personnel, functional responsibilities and to outline organizational relations amongst the individual positions

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

(4) The applicant commits to the policy that: "Personnel shall report defective NCS conditions and perform actions only in accordance with approved, plant procedures."

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

5.4.3.3 Methodologies and Technical Practices5.4.3.3Methodologies and Technical Practices

The reviewer should evaluate the applicant's NCS technical procedures to ensure that the following elements have been addressed:

(i) NCS evaluations are performed using acceptable methodologies
(ii) NCS safety and NCS operating limits on items relied on for safety are developed in an acceptable manner
(iii) NCS controlled parameters are appropriately used and applied
(iv) analytical methods used to develop NCS limits are validated

5.4.3.3.1 NCS Evaluations

The reviewer is to evaluate the applicant's technical practices to ensure that the following elements have been adequately addressed:

(i) criticality safety evaluations will be performed using acceptable methodologies
(ii) NCS limits on controls and controlled parameters will be established to ensure an adequate margin of safety
(iii) analytical methods used to develop NCS limits will be validated, including assurance that they are used within acceptable ranges, with appropriate assumptions and with acceptable computer codes
(iv) nuclear criticalities are detected promptly to ensure that radiation exposures to workers are minimized

The applicant's commitment to conduct NCS evaluations- should be considered acceptable if it fulfills the following criteria:

1. The applicant commits to conduct NCS evaluations consistent with the guidance provided in ANSI/ANS-8.1-1983, *"Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors."*

2. The applicant commits to prepare and maintain at the facility reference manuals or management-approved validation reports for each NCS methodology that is used to make an NCS determination. The manual or validation report should include:

   a. a description of the theory of the methodology in sufficient detail and clarity to allow understanding of the methodology and independent duplication of results.

   b. a description of the area(s) of applicability which 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, *"Nuclear Criticality Safety in Operations With Fissionable Material Outside Reactors,"* any extrapolation beyond the area(s) of applicability should be supported by an established mathematical methodology.

   c. a description of pertinent computer software and hardware that is used in the methodology, including codes, assumptions, and techniques

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

e. a description of the data used in the methodology consistent with reliable experimental measurements.

f. a description of the benchmark experiments that cover the intended ranges of applicability and data derived therefrom that can be 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 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 1.0 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 1.0).

h. a description of the bounding assumptions for the methodology

i. a description of the verification process and results.

3. The applicant commits to use each NCS methodology in accordance with the following principles:

a. each NCS methodology shall only be used in the area(s) of applicability specified in the facility NCS reference manual or validation report. Use in other area(s) of applicability requires written approval from the NCS program director and demonstration that trends in the bias support extension of the NCS methodology outside the area(s) of applicability.

b. mathematical relations shall only be used within the context of their fundamental assumptions and limitations

c. data shall be used consistently with reliable experimental measurements.

d plant specific benchmark experiments and data derived therefrom shall be used to validate the methodology.

e. 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 shall be established for each application of an NCS methodology.

f. appropriate software and hardware shall be used for each application of an NCS methodology.

g. the analytical, deterministic or statistical method(s) used to calculate k-eff shall be specified

4. The applicant commits to performing NCS determinations in accordance with the following principles:

a. NCS safety and NCS operating limits for items relied on for safety (controlled parameters) are 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 limit the controlled parameter to a certain range of values.

b. NCS safety limits are derived from either: (i) experimental data published in applicable ANSI standards or in industry-accepted handbooks, or (ii) using validated analytical methods

c. NCS safety limits shall be based upon application of the NCS methodology appropriate to the process under study.

d. NCS operating limits are derived from NCS safety limits by taking into consideration changes in operating parameters (e.g. changes in SNM mass, reflection, moderator mass, neutron interaction, etc.) to ensure processes will remain subcritical under both normal and credible abnormal conditions

e. NCS safety and operating limits establish sufficient margins of safety for processes and take into consideration the variability and uncertainty in a process and the NCS subcritical limit

f. The margin of subcriticality for a process operation shall be large compared to the calculated value of k-eff

g. 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. The applicant provides a summary of its commitments to prepare and maintain NCS methodologies that includes as a minimum the following:

a. concise summary of each NCS methodology used in performing NCS determinations

b. computer software, assumptions and techniques used

c. data used in each application of the NCS methodology (including any benchmark experiments)

d. validations of the NCS methodology and any verification results

e. bias, uncertainty in the bias, uncertainty in the NCS methodology and data, established margin of subcriticality and bases for these items for the selected NCS methodology

6. The applicant commits to provide information to validate the analytical, deterministic or statistical method(s) used to calculate k-eff.

5.4.3.3.2 NCS Technical Practices

The applicant's commitment to identify and use appropriate NCS technical practices should be considered acceptable if it fulfills the following criteria:

1. Based on the Performance Requirements in 10 CFR 70.61(d), the applicant commits to the policy that: "No single credible event or failure could result in a nuclear criticality accident."

2. The applicant commits to the preferred use of Passive-Engineered controls to ensure NCS. The applicant should commit to the following preference, in general, for controls to ensure NCS: (1) Passive-Engineered, (2) Active-Engineered, (3) Augmented-Administrative, and (4) Simple-Administrative.

3. The applicant commits to designate controlled parameters used in NCS as items relied on for safety and to apply Management Measures to them Controlled parameters available for NCS control include: mass, geometry, density, enrichment, reflection, moderation, concentration, interaction, neutron absorber and volume.

4. The applicant commits to measure controlled parameters using reliable methods and instruments that are sufficiently sensitive and calibrated and maintained in accordance with the manufacturer's specifications. It is acceptable if the applicant commits to representative sampling, reliable measurement instruments and methods, and dual independent measurements where there is significant susceptibility to human error.

5. NCS controlled parameters and techniques for controlling them are established based on the results of the ISA. Acceptable conditions for the use of the following NCS controls are specified below:

i.. The use of mass as a criticality controlled parameter should be considered acceptable if:

a. NCS safety limits for the controlled parameter (mass) are established based upon experimental data or validated analytical methods.

b. A percentage factor is used to determine the percentage of SNM in a given mass of material.

c. Fixed geometric devices are used to limit SNM using a conservative process density.

d. Physical measurement of mass is obtained by instrumentation.

e. When double batching of SNM is possible, the mass of SNM is limited to no more than 45% of the minimum critical Mass based on spherical geometry.

f. When double batching of SNM is not possible, the mass of SNM is limited to no more than 75% of the critical Mass.

ii The use of geometry as a criticality controlled parameter should be considered acceptable if:

a. NCS safety limits for the controlled parameter (geometry) are established based upon experimental data or validated analytical methods.

b. an evaluation is performed demonstrating that geometry will be maintained under both normal operating conditions and credible abnormal conditions.

c. All dimensions and nuclear properties relied upon for geometry control are verified before commencing operations and controls are exercised to maintain these dimensions and nuclear properties. The facility Configuration Management program should be used to maintain these dimensions and nuclear properties.

d. When using large single units, the Margins of Safety are 90% of the minimum critical cylinder diameter, 85% of the minimum critical slab thickness, and 75% of the minimum critical sphere volume.

iii. The use of density as a criticality controlled parameter should be considered acceptable if:

a. NCS safety limits for the controlled parameter (density) are established based upon experimental data or validated analytical methods.

b. Process Variables may affect the Density are identified as items relied on for safety

c. Physical measurement of the density is obtained by instrumentation.

iv. The use of enrichment as a criticality controlled parameter should be considered acceptable if:

a. NCS safety limits for the controlled parameter (enrichment) are established based upon experimental data or validated analytical methods.

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

c. Physical measurement of the enrichment is obtained by instrumentation.

v The use of reflection as a criticality controlled parameter should be considered acceptable if:

a. An appropriate safety margin is established in accordance with the acceptance criteria for NCS limits

b When investigating an individual unit, the wall thickness of the unit and all reflecting adjacent materials of the unit are considered.

c. Potential reflectors (other than the unit wall and adjacent materials specified in (b) above) are identified and suitable items relied on for safety (engineered and/or administrative controls) are established to exclude them.

vi. The use of moderation as a criticality controlled parameter should be considered acceptable if:

a. An appropriate safety margin is established in accordance with the acceptance criteria for NCS limits

b. The applicant commits to use moderation consistent with the guidance provided in ANSI/ANS-8.22-1997, *"Nuclear Criticality Safety Based on Limiting and Controlling Moderators."*

c. Process variables that may affect moderation are identified as IROFS

d. Physical measurement of the moderation, either as the mass or concentration of the moderator, is obtained by instrumentation.

e. Physical structures are designed to preclude the ingress of moderators .

f. Sampling of the moderator is conducted using appropriate sampling methods.

g. Restrictions on the use of hydrogenous materials for fire fighting activities are established in moderation control areas.

h. All credible sources of moderating materials are examined to evaluate the potential for intrusion into the moderation control area and are either precluded or appropriately controlled.

vii. The use of concentration as a criticality controlled parameter should be considered acceptable if:

a. An appropriate safety margin is established in accordance with the acceptance criteria for NCS limits

b. Process variables that may affect SNM solubility are evaluated and designated as items relied on for safety..

c. Tanks containing concentration controlled solution remain normally closed.

d. Sampling programs to measure concentration use appropriate sampling methods.

e. Possible precipitating agents are identified to the operators and appropriate precautions are taken to ensure that such agents will not be inadvertently introduced.

viii. The use of interaction as a criticality controlled parameter should be considered acceptable if:

a. The physical separation between units is evaluated and controlled using by methods evaluated in the ISA including engineered devices (e.g., spacers, racks) or augmented administrative spacing (e.g. visible markers with appropriate spacing).

ix. The use of a neutron absorber as a criticality controlled parameter should be considered acceptable if:

a. NCS safety limits for the controlled parameter (neutron absorption) are established based upon experimental data or validated analytical methods.

b. The requirements of ANSI/ANS-8.5-1996, *"Use of Borosilicate-Glass Raschig Rings as a Neutron Absorber in Solutions of Fissile Material"* are fulfilled when using borosilicate-glass Raschig rings.

c. The requirements of ANSI/ANS-8.21-1995, *"Use of Fixed Neutron Absorbers in Nuclear Facilities Outside Reactors"* are fulfilled when using fixed neutron absorbers

d. Proper neutron spectra are considered in the evaluation of the absorber effectiveness (e.g., cadmium is an effective absorber for thermal neutrons, but ineffective for fast neutrons).

x. The use of volume as a criticality controlled parameter should be considered acceptable if:

a. NCS safety limits for the controlled parameter (volume) are established based upon experimental data or validated analytical methods.

b. Geometrical devices are used to restrict the volume of SNM. Engineered devices or instrumentation limit the accumulation of SNM

c. Physical measurement of volume are made by either instrumentation or a calibrated volume device.

5.4.3.3.3 Criticality Accident Alarm System

The applicant's commitment to install and maintain a CAAS should be considered acceptable if it fulfills the following criteria:

1. The applicant commits to design and install a CAAS in areas identified in the ISA having potential nuclear criticality hazards that will reliably detect excessive radiation dose rates and signal audible alarms for conditions that require personnel evacuation. The CAAS must adequately and reliably detect an individual inadvertent nuclear criticality at the points where criticality monitoring instrumentation is placed.

2. The applicant commits to design, install and maintain a CAAS consistent with the guidance contained in ANSI/ANS-8.3-1997, *"Criticality Accident Alarm System"* and 10 CFR 70.24.

3. The applicant commits to the requirements in Regulatory Guide 3.71, *"Nuclear Criticality Safety Standards for Fuels and Materials Facilities"* which pertain to the ANSI/ANS-8.3 standard:

a. The applicant commits to criticality alarm system coverage for all processes and activities (e.g. processing, storage, handling) that the ISA identifies as potential nuclear criticality hazards

b. In contrast to the criterion in ANSI/ANS-8.3 requiring coverage by only one detector, two detectors shall be required for coverage of all areas.

c. the CAAS should be capable of detecting a nuclear criticality that produces an absorbed dose in soft tissue of 20 rads of combined neutron and gamma radiation at an unshielded distance of 2 meters within 1 minute.

(4) 4. The applicant commits to design and install a CAAS that:

1 meets the design criteria of ANSI/ANS-8.3

2 is uniform throughout the facility for the type of radiation detected, the mode of detection, the alarm signal, and the system dependability.
3 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.
4 remains operational in case of fire, explosion, corrosive atmosphere or other extreme conditions
5 is clearly audible in areas that must be evacuated

5. 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 supposedly make them safe, carries a certain real risk while, on the other hand, being without a criticality alarm for a while is clearly a comparatively small risk. The applicant should commit to compensatory measures (e.g., limit access, halt SNM movement) when the CAAS system is not functioning due to Maintenance.

6. Emergency plans are maintained where alarm systems are installed and in accordance with the following:

a. The applicant commits to undertake emergency planning consistent with the guidance provided in ANSI/ANS-8.23-1997, *"Nuclear Criticality Accident Emergency Planning and Response."*

b. The applicant either has an Emergency Plan or satisfies the alternate requirements found in 70.22.(h)(1)(i).

c. The applicant commits to provide fixed and personnel accident dosimeters in areas that require a CAAS. These dosimeters should be readily available to personnel responding to an emergency.

5.4.3.3.4 Subcriticality of Operations and Margin of Subcriticality for Safety5.4.3.3.4Requirements of 10 CFR 70.61 (Subcriticality of Operations and Margin of Subcriticality for Safety)

The applicant's commitment to ensure that all nuclear processes are maintained subcritical and operated with an acceptable margin of subcriticality should be considered acceptable if it fulfills the following criteria:

1. The applicant commits to the use of NCS controls and items relied on for safety (controlled parameters) to ensure both subcriticality of operations and margin of subcriticality for safety. As required by ANSI/ANS-8.1-1983, *"Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors,"* process specifications shall incorporate margins to protect against uncertainties in process variables and against a limit being accidentally exceeded."

2. The applicant commits to maintain nuclear processes subcritical with an acceptable margin of subcriticality consistent with the guidance provided in:

(a) ANSI/ANS-8.7-1975, *"Guide for Nuclear Criticality Safety in the Storage of Fissile Materials."*
(b) ANSI/ANS-8.9-1987, *"Nuclear Criticality Safety Criteria for Steel-Pipe Intersections Containing Aqueous Solutions of Fissile Materials."*
(c) ANSI/ANS-8.10-1983, *"Criteria for Nuclear Criticality Safety Controls in Operations With Shielding and Confinement."*
(d) ANSI/ANS-8.12-1987, *"Nuclear Criticality Control and Safety of Plutonium-Uranium Fuel Mixtures Outside Reactors."*
(e) ANSI/ANS-8.15-1981, *"Nuclear Criticality Control of Special Actinide Elements."*
(f) ANSI/ANS-8.17-1984, *"Criticality Safety Criteria for the Handling, Storage, and Transportation of LWR Fuel Outside Reactors."*

3. 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.

4. The applicant commits to the use of items relied on for safety identified in the ISA to ensure that an inadvertent nuclear criticality will not occur.

5. The applicant commits to apply management measures to ensure that items relied on for safety are reliable and available when needed.

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

5.4.3.3.5 Additional NCS Program Commitments

The applicant's additional commitments regarding the NCS program should be considered acceptable if they fulfill the following criteria:

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 program any unacceptable performance deficiencies in an item relied on for safety, NCS system or management measure so as to prevent recurrence.

2. For the design of new facilities or new processes at existing facilities that require a license amendment under 10 CFR 70.72, the applicant commits to adhere to the baseline design criteria of 10 CFR 70.64, including adherence to the double contingency principle.

3. The applicant commits to support the facility change mechanism process by performing NCS determinations, when needed, to evaluate within the facility's ISA, changes to processes, operating procedures, items relied on for safety or management measures.

4. The applicant commits to upgrade the NCS program, as appropriate, to reflect changes in the ISA or new NCS methodologies, and to recommend modifications to operating and maintenance procedures that could reduce the likelihood of occurrence of an inadvertent nuclear criticality

5. The applicant commits to implement an NCS program that ensures double contingency protection when practicable

6. The applicant commits to retain records of NCS programs and to document any corrective actions taken

7. The applicant commits to use the NCS methodologies and technical practices outlined in sections 5.3.3 of this SRP chapter to evaluate NCS accident sequences in plant operations and processes.

5.5 REVIEW PROCEDURES 5.5REVIEW PROCEDURES

5.5.1 Acceptance Review 5.5.1Acceptance Review

The Primary Reviewer should evaluate the application to determine whether it addresses the "Areas of Review" in Section 5.4. If significant deficiencies are identified, the applicant should be requested to submit additional material before the start of the safety evaluation

5.5.2 Safety Evaluation 5.5.2Safety Evaluation

The primary reviewer shall perform a safety evaluation against the Acceptance Criteria in Section 5.4 and may consult with the supporting reviewers to identify and resolve any issues of concern related to the licensing review. The primary reviewer will prepare a safety evaluation report (SER) for the Licensing Project Manager in support of licensing action.

5.6 EVALUATION FINDINGS 5.6EVALUATION FINDINGS

The reviewer will write an SER addressing each topic reviewed and explain why the NRC staff has reasonable assurance that the NCS part of the application is acceptable and that the health and safety of the workers is adequately protected. License conditions may be proposed to impose requirements where the application is deficient. The following kinds of statements and conclusions will be included in the staff's SER:

The staff has reviewed the Nuclear Criticality Safety (NCS) program for *[name of facility*] according to Chapter 5.0 of the Standard Review Plan. The staff has reasonable assurance that:

1. 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.

2. The applicant's operational plans will be based on NCS engineering and administrative practices which will ensure that the fissile material will be possessed and used safely according to the requirements in 10 CFR Part 70.

3. The applicant will develop, implement, and maintain a Criticality Accident Alarm System with corresponding emergency procedures.

4. The applicant will have in place an NCS program in accordance with the subcriticality of operations and margin of subcriticality for safety requirements in 10 CFR 70.61 and baseline design criteria requirements in 10 CFR 70.64.

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

5.7 REFERENCES 5.7REFERENCES

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

Ref: I\Files\Part 70\SRP (June 1999 Version) Sec 5. (Final).msw