January 21, 1999

Dr. Carl A. Paperiello
Office of Nuclear Material Safety and Safeguards
U.S. Nuclear Regulatory Commission
Two White Flint T8A23
Washington, D.C. 20555-0001

Dear Dr. Paperiello:

REFERENCE: **Analysis of Draft NUREG-1520 Standard Review Plan (SRP) Chapter 5 ('Nuclear Criticality Safety') and Preliminary Recommendations for Revision**

In response to a Nuclear Regulatory Commission (NRC) request for recommendations to revise draft NUREG-1520 ('*Standard Review Plan for the Review of a License Application for a Fuel Cycle Facility*'), the Nuclear Energy Institute (NEI)[1] is pleased to provide the following comments on the proposed draft SRP. The NRC proposed that the SRP revision process commence with Chapter 5 ('*Nuclear Criticality Safety*'), and that based on the experience gained from the Chapter 5 review and comments, the remaining chapters could subsequently be revised. The draft SRP is in need of revision, both to reduce its unnecessary prescriptiveness and to accurately incorporate the changes to the draft Part 70 Rule revisions that are being developed in NRC Part 70 workshops and public meetings.

The Enclosure to this letter starts with a discussion of our general, overall concerns with the content of the SRP. It continues with an annotated copy of draft SRP Chapter 5 with comments on specific sections and identification of sections that should be deleted, re-written or relocated elsewhere in the SRP. NEI has not attempted to provide a detailed mark-up of Chapter 5; our objective at this stage of the SRP review process is to identify changes that should be addressed by the NRC

[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.

Staff as it prepares a revised version of Chapter 5 for issuance in mid-February, 1999. After the NRC distributes the revised Chapter 5, NEI will undertake a more detailed review of, and where necessary, propose specific language for, Chapter 5.

NEI looks forward to continuing our dialogue with the NRC on both the Part 70 rulemaking and on the NUREG-1520 revision process. We should be pleased to address any questions which you or your staff may have on the enclosed recommendations for revision of Chapter 5 of the SRP.

Sincerely,

Marvin S. Fertel

Enclosure

cc: The Honorable Shirley A. Jackson, Chairman, NRC
The Honorable Greta J. Dicus, Commissioner, NRC
The Honorable Nils J. Diaz, Commissioner, NRC
The Honorable Edward McGaffigan, Jr., Commissioner, NRC
The Honorable Jeffrey S. Merrifield, Commissioner, NRC
Dr. William D. Travers, Executive Director for Operations, NRC
Ms. Elizabeth Ten Eyck
Mr. Andrew Persinko
Mr. Theodore S. Sherr

ENCLOSURE

ANALYSIS OF DRAFT NUREG-1520 STANDARD REVIEW PLAN (SRP) CHAPTER 5 ('NUCLEAR CRITICALITY SAFETY') AND PRELIMINARY RECOMMENDATIONS FOR REVISION

I. Introduction

NEI has reviewed Chapter 5 of the draft SRP on Nuclear Criticality Safety (NCS) to assess its consistency with proposed Part 70 rule revisions and with the ANSI/ANS-8 standards. Comments on Chapter 5 of the SRP fall into two categories: those addressing the general philosophy, organization and structure of the SRP chapter, and those addressing specific technical matters in individual chapter sub-sections. NEI's review did not extend to drafting specific replacement language for sub-sections of Chapter 5. It, instead, focused on identifying those sections of Chapter 5 which: (i) should be relocated to other chapters of the SRP, (ii) should be re-written due to inconsistencies with the proposed Part 70 rule revisions, (iii) should have technical errors corrected, or (iv) should be deleted.

An annotated (red-lined) copy of Chapter 5, which contains NEI's comments and suggested improvements, is appended to this Enclosure.

II. General Concerns

There exist several philosophical issues in the SRP that will require fundamental changes in the way licensees operate. SRP 'acceptance criteria' often seem to deviate from accepted industry standards and from facility practices which have been demonstrated to be acceptable. NEI has identified the following general comments on the draft SRP Chapter 5:

(a) Degree of Prescriptiveness

The guidance provided to a license reviewer is highly prescriptive. While the highly technical nature of NCS studies necessitates a higher level of prescriptiveness and direction for NCS than might be required for other licensing areas, the draft SRP is often not consistent with the philosophy provided by ANSI/ANS-8 standards for addressing various NCS issues through multiple approaches. The SRP often constrains a reviewer to one approach when several are possible. For example, §5.4.5.2(5) does not acknowledge that there are several ways to calculate failure limit and safety limit K_{eff} values; the SRP formulation is too specific and unnecessarily constraining. §5.4.4.3 arbitrarily mandates <u>weekly</u> audit inspections of SNM process areas and <u>quarterly</u> safety audits without any justification for the selected frequencies. Expectations that licensees will identify and justify their audit frequencies are certainly reasonable, but to specify audit frequencies in the SRP is not necessary.

NEI's principal concern is the prescriptive "*how to*" way in which this chapter has been written. The SRP language should avoid usage of all-inclusive language and connotations. It should not constrain a license reviewer's 'acceptance criteria' to a single approach presented in the SRP. The SRP should be written at a level of detail commensurate with the ANSI/ANS-8 standards. Each facility's license application should be allowed to provide a level of detail appropriate to its design features and unique characteristics.

(b) Graded Approach to Safety

Proposed rule revision §70.60(c) in SECY-98-185 required application of a graded level of protection to safety measures ('items relied on for safety') and assurance measures. This requirement has been modified in the NRC's December 1998 revision of §70.60 and §70.62 to become a permissible, but not mandatory, approach to safety management (" *…the safety program may be graded…*" [§70.62(a)(1)]). The NRC's proposal to no longer single out a potential nuclear criticality as a 'high consequence' event is appropriate and reflects a correct application of the graded approach to safety. There are numerous examples in Chapter 5 where the graded approach should be applied. Three of these examples are: (i) §5.4.4.2 (4) mandates performance-based training in NCS for *all* plant personnel regardless of their responsibilities (specifically citing the reactor program NUREG-1220 as the acceptance criterion) without considering results of the ISA, (ii) §5.4.4.1(1) requires application of the " *…highest quality assurance level…for all criticality controls…*" regardless of the number of controls protecting a system, the inherent strength and robustness of the controls and whether the ISA dictates their need, and (iii) §5.4.5.1(5) presumptively assumes that changes from a passive engineered control to an active engineered control will result in a significant increase in risk.

The SRP should appropriately reflect the fact that the rule allows licensees to adopt a graded approach to safety. This approach will permit the results of the ISA to be effectively implemented and resources to be allocated to the prevention and mitigation of accident sequences that pose the greatest risks.

(c) Use of Probabilistic Methodologies

The Commission, the Staff and industry have agreed that the most appropriate methodology for assessing risk at fuel cycle facilities is the ISA and not the use of Probabilistic Risk Analysis (PRA). In this regard, the SRP could be misleading in sections where it appears to call for 'probabilistic' analyses. For example, §5.4.6 requires use of probabilistic techniques to determine if the double contingency principle is affirmed (by requiring assignment of quantitative accident frequencies). ANSI/ANS-8 standards nowhere mandate use of such probabilistic techniques.

NEI recommends that all references to probabilistic techniques be eliminated from Chapter 5. The approach for performing evaluations of margins of safety in a system (§5.4.6) should be performed consistent with ANSI/ANS-8 guidance.

(d) Excessive Repetitiveness

While the focus of this letter is Chapter 5, there is redundancy and a lack of consistency throughout many of the chapters of the SRP. For example, most chapters of the SRP contain subsections on 'Training Requirements', 'Quality Assurance', 'Management Control Systems, 'Audits, Assessments and Investigations', and 'Organizational Requirements'. Inappropriate inconsistencies would be eliminated and the SRP would be a much more user-friendly document if these subchapters were removed from each chapter of the SRP and replaced by a single chapter for each topic. There would, for example, be a single chapter on ‘Training Requirements’ to which reference would be made from individual SRP chapters. Reference can be made in Chapter 5 to these all-encompassing SRP chapters on ‘Quality Assurance’, ‘Management Control Systems’ etc., thereby reducing the repetitiveness of the SRP, decreasing its size, and minimizing the potential for inconsistencies.

Chapter 5 attempts to repeat, interpret or expand upon many topics adequately addressed in ANSI/ANS-8 standards. This is not necessary and has resulted in several misinterpretations of the standard that the NRC has repeatedly endorsed. There is no need for this interpretive text. Rather, NEI recommends Chapter 5 refer the license reviewer to ANSI/ANS-8 standards as the basis to judge the adequacy of an application against its benchmarks requirements.

(e) Definition Redundancies

Definitions appear in Chapter 5 that are found elsewhere in the Part 70 rule, in the ANSI/ANS-8 standard, or in the SRP. Reference to these definitions should be made rather than attempting to redefine a term in a manner that is inconsistent with the Rule or ANSI/ANS-8 standard. Redundant definitions also should be removed. For example, several terms defined in §5.4.0 do not appear to be used elsewhere in Chapter 5 (e.g. ‘criticality control system’). Conversely, terms are used which are not defined and which are used in a manner that prompts confusion (e.g. ‘safety margin’). The language of several definitions should be clarified to remove ambiguity. For example, the term ‘adequate margin of safety’ should be stated to be “adequate margin of sub-criticality’ (§5.4.5.1 (7)). Specific deficiencies in definitions in Chapter 5 include, for example: (i) separate definitions of ‘double contingency’ and ‘double contingency principle’ in §5.4.0 that are redundant. The ANSI/ANS-8 definition of double contingency would be sufficient, (ii) the definition of ‘dual sampling’ is erroneous (see red-lined Chapter 5 for correction), and (iii) the definitions of ‘items relied on for safety’ contained in the rule and Chapter 5 are inconsistent:

Proposed Rule Definition: “*…structures, systems, equipment, components and activities of personnel that are relied on to prevent or mitigate potential accidents at a facility*.”

Proposed Chapter 5 Definition: “*…a control or a modifiable characteristic of a system, regardless of its designation or principal use, that is relied on for safety. A process control would normally not be an item relied on for safety if there exists a separate independent designated safety control on the same controlled parameter to prevent safety limits from being exceeded. However, if a process control or characteristic is used to justify compliance with double contingency or with the safety performance likelihood requirements of 10 CFR 70.60(c), then it is an item relied on for safety.*”

NEI recommends that technical definitions (and acronyms) be consolidated into a single chapter of the SRP.

(f) Adherence to ANSI/ANS-8 Standards -- ANSI/ANS-8 References

In several instances the draft Chapter 5 attempts to go beyond the requirements of ANSI/ANS-8 in establishing acceptance criteria for NCS programs. Given the NRC accepts the ANSI/ANS-8 standard as the basis for developing an NCS program, the additional requirements sought by the SRP over and above double contingency are unnecessary. For example, in those areas where double contingency is met with robust systems, there is no reason for assurance measures on such controls or controlled parameters to be 'of the highest standard.' Application of the NRC's graded level of protection philosophy would also no longer dictate that such assurance measures be 'of the highest standard' unless so required by the ISA.

Whenever the ANSI/ANS-8 standards are cited, specific reference to its applicable chapter and section should be cited to enable the reviewer to quickly consult the appropriate and applicable section of the standard.

(g) Chapter Structure and Style

The structure of Chapter 5 often is difficult to follow. For example, the introduction to Chapter 5.3 identifies four areas of review. However, the four subsections §5.3.1-5.3.4 neither faithfully nor clearly follow how these four introductory topics are presented.

Different chapters of the draft SRP appear to have been written by different individuals. The level of detail and 'how-to' prescriptiveness, repetitiveness of definitions and sub-topics common to several SRP chapters (e.g. management systems, training, audits, etc.) and adherence to Part 70 rule provisions substantially differ.

Several instances occur in §5.4 '*Acceptance Criteria*' where controls are mentioned without there being a clear linkage back to any acceptance criterion.

NEI recommends that the entire SRP be reviewed by technical editors to ensure consistency in language, degree of detail and structure among individual chapters prior to its final issuance.

(g) ISA Results and ISA Summary

Chapter 5 needs to be modified to reflect the current content of the proposed rule revisions and the guidance provided by the Commission in the SRM. The draft SRP was written on the presumption that the detailed 'results of the ISA' would be included in the license, but this is no longer the case. Chapter 5 appears to anticipate incorrectly that the controls for every process or operation are to be identified and described in the license.

(h) Breadth of License Application Review

The draft SRP prescribes a much broader and extensive review of NCS technical data than should be required. The SRP directs that detailed reviews be performed of internal NCS evaluations and assessments on specific systems and/or specific credible accident scenarios identified in the ISA. NRC reviewers should, in contrast, focus on reviewing the broader NCS *program* (basic commitments, adequately trained personnel, review procedures, etc.) and the specific highest risk sequences. For example, §5.4.5.1 states that the "*…application specifies the basis of nuclear criticality for each process…*" and that "*…the applicant demonstrates for each system that could cause a nuclear criticality, that the system possesses double contingency…*" Review of each process or system is not necessary and will be very time-consuming. Only those higher risk accident sequences reported in the ISA Summary should be reviewed at this level of detail.

III. Specific Concerns

Specific concerns with individual sub-sections of Chapter 5 are presented on the attached, red-lined version of Chapter 5. Most annotations identify general concerns with a section or indicate that the section should be relocated elsewhere in the SRP or deleted. Only on a very few limited occasions is new language proposed for inclusion in the SRP.

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U.S. NUCLEAR REGULATORY COMMISSION

STANDARD REVIEW PLAN

OFFICE OF NUCLEAR MATERIAL SAFETY AND SAFEGUARDS

5.0 NUCLEAR CRITICALITY SAFETY (NCS)

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OFFICE OF NUCLEAR MATERIAL SAFETY AND SAFEGUARDS

5.0 NUCLEAR CRITICALITY SAFETY (NCS)

5.1 PURPOSE OF REVIEW

The purpose of this review is to determine whether the applicant has (1) assessed accident sequences identified in the integrated safety analysis (ISA) that could result in conditions leading to a nuclear criticality; (2) implemented, with supporting analyses, adequate controls and limits on the parameters relied upon to prevent a nuclear criticality for those conditions; (3) established an acceptable organization with which to implement the NCS program to control the parameters relied upon for NCS; and (4) established associated management control systems needed to maintain NCS.

Comment: The order in which the 4 purposes are presented should parallel the order in which they are discussed in the following subsections. Purpose (1) of this review is incorrectly stated: the reviewer will not review **all** accident sequences addressed in the ISA, but only those higher risk sequences which are presented in the ISA Summary.

5.2 RESPONSIBILITY FOR REVIEW

Primary: Nuclear Process Engineer (Nuclear Criticality)

Secondary: Chemical Safety Reviewer

Supporting: Project Manager, Fuel Cycle Inspector, and ISA Reviewer

5.3 AREAS OF REVIEW

The NRC staff will review the application to ensure that the NCS program: (1) provides adequate protection for the accident sequences identified in the ISA Summary as leading to the possible occurrence of an inadvertent nuclear criticality; (2) establishes adequate NCS safety limits and controls, and analyses to support their use, for the items (i.e., structures, systems, equipment, components, and activities of personnel) relied upon to prevent a nuclear criticality; (3) identifies responsibilities and authorities for individuals implementing the NCS program in the facility organization to adequately control parameters relied upon for NCS and to afford adequate means to develop, implement, maintain, and upgrade the NCS function, as appropriate; and (4) furnishes adequate management control functions, as described in the application, associated with the NCS function (e.g., configuration management, maintenance, management measures ~~quality assurance~~, and training) that help to ensure NCS when using parameters or controls identified in the ISA Summary as important for preventing a nuclear criticality.

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The NRC staff will also review the applicant's requirements for criticality accident alarm systems to ensure that the applicant provides for immediate detection and annunciation of an inadvertent nuclear criticality and to ensure that the applicant safely evacuates personnel if an inadvertent nuclear criticality should occur.

The specific areas for review are as follows:

5.3.1 NCS Organizational Responsibilities

Comment: move this section to Chapter 2.0 of SRP, consolidate and remove redundancies and inconsistencies, and reference reviewer to that chapter

The staff will review the application to ensure that the applicant has established an organization that has appointed individuals with the requisite responsibilities and authority for ensuring NCS. The following areas of the application related to the applicant's NCS organization will be reviewed:

1. The administrative organization of the NCS program, including the authority and responsibility of each position identified, and the applicable activities of the individuals in management having responsibility for NCS

2. The experience and qualifications criteria of the personnel responsible for NCS

5.3.2 **Management Control Systems for NCS**

Comment: move this section to Chapter 11.0 of SRP, consolidate and remove redundancies and inconsistencies and reference reviewer to that chapter.

The staff will review the management control systems in the application to ensure that the applicant has committed to sufficient control systems to ensure continued availability and reliability of controls to ensure NCS in the following programmatic areas:

1. Configuration management, as changes are made to the facility that may affect NCS, to provide documentation and record-keeping of the (1) process description, (2) process and equipment design, (3) as-built drawings, (4) operating procedures, (5) maintenance and testing of NCS control instruments, and (6) NCS evaluations and limits

2. Maintenance to ensure that controls identified in the ISA Summary as important to NCS are ~~continually~~ available and reliable when required to perform their functions.

3. Comment: change "quality assurance" term to "management measures" (here and throughout the balance of Chapter 5). ~~Quality assurance~~ Management measures to ensure that components important to NCS are properly specified, obtained, installed, operated, and maintained.

4. Training for all employees to provide reasonable assurance that human actions that may affect NCS are performed reliably and predictably.

5. Inspections, audits, self-assessments, and investigations to identify and correct deficiencies that may arise and to ensure that improvements are made to the NCS program, as needed

5.3.3 NCS Technical Practices

Comment: this section contains language that could be interpreted to provide for NRC review of individual Nuclear Criticality Safety Evaluations (NCSEs), NCS controls and double contingency analyses. NRC staff review should focus on the NCS program (i.e. basic commitments, adequately trained personnel, procedures for review to ensure adequate NCS, etc.), rather than on detailed NCSEs of specific scenarios or systems. As the detailed "results of the ISA" are no longer proposed for inclusion in the license application, only the broad framework of the NCS program and those higher risk accident sequences contained in the ISA Summary should be reviewed by NRC staff.

The staff will review the NCS technical practices in the application to ensure that the applicant has adequately addressed the following elements:

1. Criticality safety evaluations to ensure that the specific criticality controls that form the basis of NCS, consistent with the ~~results of the~~ ISA Summary, are identified for each process, system, and equipment function. Comment: Note that the controls should not have to be reviewed for "*…each process, system and equipment function*…", but only for those higher risk accident sequences identified in the ISA Summary. If the ISA determines that a nuclear criticality is not possible in a particular process, such a review will also be unnecessary.

2. NCS controls and control parameters ~~limits on controls and controlled parameters~~ to ensure that an adequate safety margin of subcriticality exists.

3. Analytical methods to ensure that the methods used to develop NCS limits are validated; that the range of applicability of a given method is determined; and that use of, or proposals for, pertinent codes, assumptions, and techniques for the methods are described and appropriately evaluated. Is it the intent of the NRC to perform independent technical reviews of computer code calculations? This should not be the case.

4. The assurance level of controls identified by the ISA Summary to ensure that controls relied on for NCS will function reliably.

5. Nuclear criticality detection to ensure that the radiation exposure to workers is minimized by promptly alerting personnel of an inadvertent nuclear criticality.

6. Information describing implementation of special protective features, as applicable, and information describing any additional margins of subcriticality ~~safety~~ adopted as a result of the ISA process, for specific functions or activities. What is the definition of "special protective features"?

7. Enough detail is provided so that criticality controls and double contingency analyses can be reviewed and inspected by NRC and licensee staff. This includes providing examples of the input data that involve major modeling changes. Comment: This amount of requested detail exceeds that provided in the past. If license applicants must provide this level of detail in an application, a document control and management system will also be required so that only certain models of system components will be used to ensure consistency in modeling and will require a license amendment if the NRC analyst chooses to change the computer model in some fashion. This level of detail should only be required by a second party reviewer. Also, the level of detail would require sending many proprietary drawings along

with the major sections of each ISA as part of the license application. As noted for item (1) above, the review should be limited to a review of those higher risk accident sequences identified in the ISA Summary.

5.3.4 ISA SummaryResults

Comment: move this section to Chapter 3.0 of the SRP, consolidate and remove redundancies and inconsistencies and reference the reviewer to that chapter.

The staff will review the ISA Summary ISA results in the application [Note: the results of the ISA and the ISA Summary are **not** part of the license application] to ensure that the applicant has adequately addressed the following elements:

1. Potential accident sequences that could result in an inadvertent nuclear criticality, including the effects of external initiating events such as fires and loss of electrical services

2. Specific controls or barriers relied on to provide reasonable assurance that an inadvertent nuclear criticality will not occur

3. Provisions to ensure that the specified NCS controls or barriers receive the required levels of maintenance, management measures quality assurance, and training in their operation; that adequate procedures for the controls are created and followed; and that controls are managed within the facility's configuration management program

5.4 ACCEPTANCE CRITERIA

5.4.0 Definitions

Comment: use only terms as defined in consensus standards (ANSI/ANS 8.1) or that are presented in the Part 70 Rule

The following definitions are provided to help the reviewer better understand the conceptual basis for the NCS guidance given in this chapter:

Control means an engineered device, either active or passive, or a human (administrative) action established to limit (1) the behavior of individuals to prescribed actions or (2) the operation of a component, a process, a portion of a process, or a system to performance within defined limits to prevent or mitigate an accident. Accordingly, the general term "controls" in this SRP is understood to include passive barriers such as structures, vessels, and piping; active-engineered features such as valves, thermocouples, and flowmeters; and administrative controls that require human actions to be taken in accordance with approved normal operating or emergency procedures.

Controlled parameter means a measurable quantity (e.g., mass, geometry, concentration, enrichment) the value of which is maintained within established limits by specific controls to ensure the safety of an operation.

Criticality control system means a combination of engineered devices or human actions that effectively function as a single criticality control, but, when used individually, do not.

Comment: make the definition of "Double Contingency Protection" consistent with that in the ANSI/ANS-8 standard and delete the second redundant "Double Contingency" definition.

~~**Double contingency :** A process design possesses double contingency if it incorporates sufficient factors of safety to require at least two unlikely, independent and concurrent changes in process conditions before a criticality accident is possible.~~

Double contingency protection ~~principle~~: Licensed processes should, in general, possess double contingency with respect to nuclear criticality accidents. Double contingency is the standard, exceptions should be made only when double contingency is not feasible.

Dual sampling means two separate samples which are performed by either two different methods or two different persons. Comment: Dual sampling should not require "two different methods" to be valid. If sampling is not considered in the total picture of "measuring", then "two different methods" could, in fact, give incorrect results for both. Thus, modify this definition to allow for other methods of dual sampling, or ensure that the definition permits collection of two or more samples with no common mode failure.

Item relied on for safety means a control or a modifiable characteristic of a system, regardless of its designation or principal use, that is relied on for safety. A process control would normally not be an item relied on for safety if there exists a separate independent designated safety control on the same controlled parameter to prevent safety limits from being exceeded. However, if a process control or characteristic is used to justify compliance with double contingency or with the safety performance likelihood requirements of 10 CFR 70.60(c), then it is an item relied on for safety. Comment: This definition is inconsistent with that provided in the Rule and in other sections of the SRP. It must be re-written to agree with the Rule definition:

> ***Item Relied on for Safety*** *means structures, systems, equipment, components and activities of personnel that are relied on to prevent or mitigate potential accidents at a facility.*

Independent, as used in double contingency or with reference to control failures and other events in accident sequences, means that the probability of failure of one event is the same, regardless of whether the other event has occurred. This means not only that there exists no event that is a common cause of both of the events in question, but that the occurrence of either does not influence the probability of the other. Independence may not hold for two safety controls when failure of one control causes process or environmental conditions that place stress on the other control. Two administrative safety procedures performed by the same individual, or by a group of individuals in close cooperation, cannot be independent.

Comment: the definitions of "failure limit" and "safety limit" are far too specific and can not be applied to all facilities. These definitions should be deleted.

~~**Failure limit** means the best estimate value of a controlled parameter such that there exists a normal or credible abnormal event which causes Keff to exceed 1. When applied in double contingency on two separate parameters, the failure limit for each parameter is based on assuming the value of the other parameter is at its safety limit. A calculated value~~

~~of Keff at the failure limit may differ from 1 if systematic bias is included in the best estimate value.~~

~~**Safety limit** means a limit on a controlled parameter that has sufficient margin for uncertainties, abnormal events, and process variations so that there is high confidence that the system will truly be subcritical as intended. Margins would normally be included for both estimated and unknown uncertainties (administrative margin) in determining Keff, and for uncertainties in determining or controlling the actual value of the controlled process parameter. Keff at the safety limit is always less than 1.~~

5.4.1 Regulatory Requirements

The regulatory basis for the review is the general and additional contents of an application as required by 10 CFR 70.22 and 70.65, respectively. In addition, the NCS review is conducted to ensure compliance with 10 CFR 70.24, 70.60, and 70.62.

5.4.2 Regulatory Guidance

Comment: the list of regulatory guidance documents should be shortened to one (or possibly) two. In August 1998 NRC published Regulatory Guide 3.71 which endorsed **ALL** of the ANSI/ANS-8 standards with some minor exceptions. Just published has been ANSI/ANS-8.1-1998 standard ("*Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors*") which provides the first real change of that standard since 1983. Thus, only Reg. Guide 3.71 and ANSI/ANS-8.1-1998 need to be referenced. Note that with the publishing of Reg. Guide 3-71 the NRC has withdrawn eight of the Reg. Guides listed below (3.1, 3.4, 3.13, 3.15, 3.57, 3.58, 3.68 and 8.12),

The NRC regulatory guides below endorse ANSI/ANS-8 national standards in part or in full. ANSI standards provide more detailed guidance, as endorsed in part or in total by NRC regulatory guides. Applicable regulatory guides and national standards for this SRP are the following:

1. ANSI/ANS-8.1-1998, "Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors"

2. Regulatory Guide 3.71, "Nuclear Criticality Safety Standards for Fuels and Materials Facilities (Draft DG-3013 published 1/98)

~~1.Regulatory Guide 3.1, "*Use of Borosilicate-Glass Raschig Rings as a Neutron Absorber in Solutions of Fissile Material*," and ANSI/ANS-8.5-1986, "Use of Borosilicate-Glass Raschig Rings as a Neutron Absorber in Solutions of Fissile Material"~~

~~2.Regulatory Guide 3.4, "*Nuclear Criticality Safety in Operations with Fissionable Materials at Fuels and Materials Facilities*," and ANSI/ANS-8.1-1983, "Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors"~~

~~3.Regulatory Guide 3.43, "*Nuclear Criticality Safety in the Storage of Fissile Materials*," and ANSI/ANS-8.7-1975, "Guide for Nuclear Criticality Safety in the Storage of Fissile Materials"~~

~~4.Regulatory Guide 3.45, "*Nuclear Criticality Safety for Pipe Intersections Containing Aqueous*~~

~~*Solutions of Enriched Uranyl Nitrate*," and ANSI/ANS-8.9-1987, "Nuclear Criticality Safety Criteria for Steel-Pipe Intersections Containing Aqueous Solutions of Fissile Material"~~

~~5.Regulatory Guide 3.57, "*Administrative Practices for Nuclear Criticality Safety at Fuels and Materials Facilities*," and ANSI/ANS-8.19-1984, "Administrative Practices for Nuclear Criticality Safety"~~

~~6.Regulatory Guide 3.58, *"Criticality Safety for Handling, Storing, and Transporting LWR Fuel at Fuels and Materials Facilities*," and ANSI/ANS-8.17-1984, "Criticality Safety Criteria for the Handling, Storage, and Transportation of LWR Fuel Outside Reactors"~~

~~7.Regulatory Guide 3.68, "*Nuclear Criticality Safety Training*," and ANSI/ANS-8.20-1991, "Nuclear Criticality Safety Training"~~

~~8.Regulatory Guide 8.12, "*Criticality Accident Alarm System*," and ANSI/ANS-8.3-1986, "Criticality Accident Alarm System"~~

~~9.Draft Regulatory Guide DG-3011, "*Use of Fixed Neutron Absorbers at Fuels and Material Facilities*," and ANSI/ANS-8.21-1995, "Use of Fixed Neutron Absorbers in the Design of Nuclear Facilities Outside Reactors"~~

5.4.3 NCS Organizational Responsibilities

Comment: move this subsection to SRP Section 2.0, consolidate and remove redundancies and inconsistencies and reference reviewer to that chapter. Several items are too prescriptive and need to be re-written.

For the purposes of the NCS review, the organization and management system are considered acceptable if the applicant has met the following acceptance criteria:

1.The applicant's organization and management system provides for all elements contained in ANSI/ANS-8.19, "Administrative Practices for Nuclear Criticality Safety."

2.The applicant has described the organizational positions, functional responsibilities, experience, and adequate qualifications of persons responsible for NCS.

3.The plant organization, the functional responsibilities, and the qualifications of personnel meet the acceptance criteria of SRP Chapter 2.0, "The Applicant's Organization," Section 2.1.4. Comment: there is no §2.1.4 in the SRP

4. Management clearly establishes responsibility for NCS at the facility.

5. Comment: this requirement is too prescriptive and should be deleted ~~Management provides personnel skilled in the interpretation of data pertinent to NCS and familiar with the operation of the facility to serve as advisors to supervision. These specialists are, to the extent practicable, administratively independent of process supervision.~~

6. Comment: there should not be a requirement that the ISA team member with NCS experience be part of the facility management. This item should be deleted. ~~The ISA team~~

~~includes an individual with the appropriate NCS experience and qualifications, who is part of the management at the plant during construction and operations.~~

7. Comment: this topic should be addressed in SRP Chapter 11.5. Written procedures are not the only means to implement NCS controls and limits. This section should be revised to eliminate its overly prescriptive nature by deleting the second and third sentences. Written procedures govern operations pertinent to NCS. ~~The applicant establishes procedures that include controls and limits significant to the nuclear criticality safety of the operation and that specify all parameters procedurally controlled. The applicant also commits to write procedures such that no single, inadvertent departure from a procedure can cause a criticality accident.~~

~~9.~~ Comment: this subsection should be deleted as it contains overly prescriptive "how to" elements. ~~The applicant commits to provide postings for a particular area, operation, work station, or storage location that describe the administrative limits and controls appropriate for providing operators a ready reference for verifying conformance and safe operation. Labels for storage vessels containing SNM in these areas adequately describe the type and amount of material.~~

9. Comment: This section should be moved to SRP Chapter 11.8 because it essentially involves an incident investigation. The term "policy" should be used instead of "operating instructions" or "mandatory procedures." The applicant commits to specifying a policy ~~mandatory procedure~~ that all personnel should report defective NCS conditions to the NCS Function~~, and take no further action not specified by written operating instructions until NCS has analyzed the situation.~~

5.4.4 Management Measures ~~Control Systems~~ for NCS

The following management measures are ~~elements of management control systems~~ specific to NCS. Additional acceptance criteria for management measures ~~control systems elements~~ regarding configuration management and maintenance are contained in SRP Chapter 11.0, "Management Controls Systems," Sections 11.1 and 11.2. The eight bullet items in §70.62(d) should be deleted from the rule and inserted into this section to ensure that the licensee has adequate and effective Management Measures The existing sub-sections §5.4.4.1, §5.4.4.2, §5.4.4.3 and §5.4.4.4 are all to be relocated from this §5.4.4 "Management Measures" to other chapters of the SRP.

(1) Engineered controls that are identified as relied on for safety pursuant to §70.60(d) of this part are designed, constructed, inspected, calibrated, tested and maintained, as necessary, to ensure the ability to perform their intended functions when needed. Items subject to this requirement include, but are not limited to: principal structures of the plant, passive barriers relied on for safety (e.g. piping, glove boxes, containers, tanks, columns, vessels); active systems, equipment and components relied on for safety; sampling and measurement systems used to convey information about the safety of plant operations; instrumentation and control systems used to monitor and control the behavior of systems relied on for safety; and utility service systems relied on for safety.

(2) Personnel are trained, tested and retested, as necessary, to ensure that they understand, recognize the importance of, and are qualified to perform their duties that are identified as

relied on for safety pursuant to section §70.60(d) of this part;

(3) Procedures that are identified as relied on for safety pursuant to section §70.60(d) of this part are developed, reviewed, approved and distributed to ensure that personnel are able to perform their duties relied on for safety;

(4) Human-system interfaces are designed and implemented to ensure that personnel relied on for safety are able to perform their duties that are identified as relied on for safety pursuant to section §70.60(d) of this part;

(5) Configuration changes to site, structures, process, systems, equipment, components, computer programs, personnel, procedures and documentation are managed so that such modifications are reviewed, documented, communicated and implemented in a systematic, coordinated manner.

(6) Management measures that are commensurate with the item's reduction of risk is applied to each item relied on for safety identified pursuant to section §70.60(d) of this part.

(7) Periodic audits and assessments of the safety program are performed to ensure that an adequate level of protection is maintained at the facility

(8) Abnormal events are investigated and corrective actions taken to minimize the recurrence of these events

5.4.4.1 Management Measures ~~Quality Assurance~~ for NCS

Comment: Move this entire subsection to SRP Chapter 11.3, consolidate and remove redundancies and inconsistencies and reference reviewer to that chapter.

An applicant's management measures are acceptable if: ~~To provide for NCS, the applicant's quality assurance program is considered acceptable if the applicant has met the following acceptance criteria~~:

~~1. The highest quality assurance level (as defined by the applicant in accordance with SRP Section 11.3, "Quality Assurance") is provided for all criticality controls used to ensure double contingency~~. Comment: eliminate this item as it is not consistent with draft rule revisions. Also, §11.3.4.2 refers to NQA-1 and flexibility should be provided to reference other QA systems (e.g. ISO standards). QA levels for criticality controls is to be based on a graded level of risk.

2. NCS codes and software are subject to management measures ~~quality assurance controls~~.

~~3. Quality assurance is applied to processes that use representative samples and measurements to establish NCS limits.~~Comment: the meaning of this item (3) is unclear.

~~4. Supervision verifies compliance with NCS specifications of new or modified equipment before its use (e.g., based on inspection reports from the applicant's quality assurance function).~~
Delete item 4 as it is not consistent with standard facility practices. It is a constituent of the

Configuration Management program.

5. ~~The number and effectiveness of controls are considered when applying the quality assurance program. Depending on the unmitigated risk of an accident sequence, the degree to which a control is relied upon (i.e., whether it is the only control or one of several) and on the technique used for control (see SRP Section 5.4.5.2, "NCS Limits"), the quality assurance program is appropriately graded to that specific control or the highest assurance level is used.~~ Comment: delete this section and consider the grading of assurances in the Technical Practices section (§5.4.5).

5.4.4.2 Training.4.4.2 Training.4.4.2 Training

Comment: This section should be relocated to SRP Chapter 11.4 (Training), consolidate and remove redundancies and inconsistencies and reference the reviewer to that chapter.

To provide for NCS, the training program of the applicant is considered acceptable if the applicant has met the following acceptance criteria:

1. The applicant's training program provides for all elements contained in ANSI/ANS-8.20, "Nuclear Criticality Safety Training" that are endorsed by Regulatory Guide 3.68, "*Nuclear Criticality Safety Training*."

2. The applicant actively involves individuals responsible for NCS in the development and implementation of NCS training and in the evaluation of its effectiveness.

3. Performance-based training should not be mandated for fuel cycle facilities. The level of training is to established by the ISA. Items 3, 4, and 6 should be deleted because NUREG 1220 (nuclear power reactors) does not apply. ~~Performance-based training is established for all plant personnel.~~

~~4. Performance-based training includes the following:~~

- ~~a. An analysis of jobs and tasks to determine what a worker must know to function effectively;~~
- ~~b. Design and development of learning objectives based on the analysis of jobs and tasks that reflect the knowledge, skills, and abilities needed by the worker;~~
- ~~c. Development of instructional materials based on the learning objectives;~~
- ~~d. Implementation of a training program to achieve the performance objectives identified in the analysis and design phase of the facility; and~~
- ~~e. Evaluation and, as appropriate, revision of the training program based on internal and external audits and results obtained from written, oral, and operational examinations.~~

5. Items (5) and (7) should be deleted from this section and incorporated into the general training requirements section of SRP Chapter 11.4 ~~The NCS training program includes instruction concerning implementation of revised or temporary procedures.~~

6. The evaluation of the development and implementation of the NCS training program uses methods cited in NUREG-1220, "Training Review Criteria and Procedures" (Revision 1, January 1993). Comment: NUREG-1220 applies to nuclear reactors, not fuel cycle facilities.

7. The number and effectiveness of controls are considered when applying the training program. Depending on the risk significance of the accident sequence, the degree to which a control is relied upon (i.e., whether it is the only control or one of several) and on the technique used for control (see SRP Section 5.4.5.2, "NCS Limits"), the training program is appropriately graded to that specific control or the highest assurance level is used. Comment: emphasize this idea in SRP Chapter 11.4

5.4.4.3 Operational Inspections, Audits, Assessments, and Investigations

To provide for NCS, the program for operational inspections, audits, assessments, and investigations is considered acceptable if the applicant's program includes the following elements:

1. Consistent with ANSI/ANS-8.1 §4.1.6, "Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors," operations are reviewed at least annually to ascertain that procedures are being followed and that process conditions have not been altered to adversely affect NCS. These reviews are conducted, in consultation with operating personnel, by applicant staff who are knowledgeable in NCS and who (to the extent practicable) are not immediately responsible for the operations.

2. Audit frequencies should not be specified; they will be established by the ISA and will differ for each facility Quarterly sSafety audits are conducted in a manner such that all NCS aspects of management control systems are regularly audited at least every 2 years.

3. Inspection frequencies should not be specified; they will be established by the ISA and will differ for each facility. Weekly NCS inspections of all operating SNM process areas are to be regularly conducted and appropriately documented. Significant weaknesses in controls are promptly and effectively resolved.

4. Comment: this section should be relocated to SRP Chapter 11.7 or 11.8 where it should be consolidated and redundancies and inconsistencies removed and the reviewer referenced to the appropriate chapter The number and effectiveness of controls are considered when applying the program for operational inspections, audits, assessments, and investigations. Depending on the degree to which a control is relied upon (i.e., whether it is the only control or one of several) and on the technique used for control (see SRP Section 5.4.5.2, "NCS Limits"), the program for operational inspections, audits, assessments, and investigations is appropriately graded to that specific control or the highest assurance level is used.

5.4.5 NCS Technical Practices

Comment: §5.4.5 appears to require NRC approval of individual nuclear criticality safety evaluations (NCSEs) including identification of controlled parameters, design criteria for those parameters and controls on those parameters for each process. This also includes review of compliance with double contingency for each system. This section discusses an NCS program change procedure that is not consistent with the proposed §70.72 change procedure and adds a "decrease in effectiveness" criterion not contained in the draft rule revisions. This section must be brought into compliance with the proposed rule revisions.

5.4.5.1 Criticality Safety Evaluations

Comment: this section implies a review of process specific evaluations. The section should be rewritten to require an applicant to specify the ground rules for criticality safety evaluations. It should be restructured to include a review of the applicant's commitments to perform evaluations and not a review of specific process evaluations.

Criticality safety evaluations are considered acceptable if the following criteria are met:

1. **Specification of the Nuclear Criticality Safety Basis**: The application specifies the basis of nuclear criticality safety for each process. This may be accomplished by specifying one of the following for each accident sequence:

    a. Specific controlled parameters and associated design criteria for the parameters, which when limited to specified values provide for NCS, or

    b. Specific controls, which limit these parameters, or

    c. A combination of criteria 1.a and 1.b.

    The effects of changes in controls and controlled parameters, or in the conditions to which they apply, are also evaluated as part of the ISA.

2. **Adherence to the Double Contingency Principle**: The applicant commits to implement ~~demonstrate, for each system that could cause~~ a nuclear criticality safety program that ensures double contingency as defined in ~~section 5.4.0 above. As stated there and in~~ ANSI/ANS-8.1., A~~a~~dherence to the double contingency principle requires that process and equipment designs and operating procedures incorporate sufficient factors of safety to require at least two unlikely, independent and concurrent changes in process conditions before a criticality accident is possible.

    Protection shall be provided by either: (i) the control of two independent process parameters, or (ii) a system of multiple, independent controls on a single process parameter. The former method, two parameter control, is the preferred approach due to the difficulty of preventing common mode failure when controlling only one parameter. In all cases, to possess double contingency, no single credible event or failure shall result in a criticality accident.

    ~~In calculating Keff for processes the values of certain process dimensions or other parameters may be set conservatively in the analysis. For example, full reflection may be assumed if this is credible. This is done when the subject parameters are not controlled, or to account for uncertainties, such as dimensional tolerances. This means that, at times, the actual value for that parameter may be less reactive than the limiting value used in the analysis. Such conservatism may often provide additional margin to criticality. However, in evaluating compliance with double contingency, this margin cannot be relied on by assuming that the parameter will have a lower value unless there is a declared safety control that assures this lower value.~~

~~The term "concurrent" as used in double contingency means that the effect of the first process change persists until the second change occurs, at which point the system is at or above critical. It does not mean that the two events initiating the change must occur simultaneously. For example, a potentially critical mass of UO_2 could be spilled on the floor, then, before it is removed, a water leak could provide the moderation needed for criticality. It is the state of the criticality parameters that is of interest. Another important point is that the likelihood of criticality can be markedly reduced if failures of criticality controls are rapidly detected and the processes rendered safe. If not, processes can remain vulnerable to the second failure for extended periods of time.~~

~~3. **Exceptions to the Double Contingency Principle**: In as far as implementing the double contingency principle as stated in the ANSI/ANS-8.1 standard for all processes may not be practicable, the staff will accept the following exception with adequate justification in the application:~~

~~In those processes where it has been determined that double contingency is not practicable to implement, the facility will implement sufficient redundancy and diversity in control parameters for these processes such that at least two unlikely and concurrent events errors, accidents, or equipment malfunctions, are necessary before a criticality accident is possible.~~

~~If there is any dependence between the two events, it should be taken into account in assessing the likelihood, so that the occurrence of both events together is highly unlikely. This dependence can happen because one event causes the other to become more likely, or because occurrence of some other event increases the likelihood of both of the two events. This latter type can be the occurrence of a fire or other environmental degradation, the use of non-diverse equipment, or the same operator performing two actions.~~

~~Another type of dependence that must be considered is common cause failure, that is, a single event failure. If any such single event exists that could cause criticality, it by itself must qualify as highly unlikely.~~

~~Adequate justification for allowing an exception to the double contingency principle includes the following:~~

~~a. The impracticality of implementing the double contingency principle is thoroughly documented by showing the excessive costs and severe operational burdens that would be imposed on the facility compared to the risk reduction gained by implementing the principle.~~

~~b. Enough redundancy and diversity exist to ensure that the controls used in the exception are not subject to common mode failure. This is explicitly considered as part of the applicant's ISA.~~

Item 4 looks like guidance for an inexperienced criticality engineer, and is not appropriate in a SRP. This section should require a review of the commitments made by licensee on how process parameters are controlled.

~~4. **Safety Determination for Processes**: The entire process is determined to be subcritical~~

under both normal and credible abnormal conditions. A determination that a process will be subcritical under both normal and credible abnormal conditions considers the following examples of variations in process conditions:

a. Changes in intended shape or dimensions resulting from bulging, corrosion, or bursting of a container, or from failures to meet fabrication specifications;

b. Possible changes in the mass of SNM at a location due to operational errors, improper labeling, equipment failure, or failure of analytical techniques;

c. Changes in the moderator to SNM ratio from:
   1. Inaccuracies in instruments or chemical analyses,
   2. Flooding, spraying, etc.,
   3. Evaporating or displacing moderator,
   4. Precipitating SNM from solutions,
   5. Diluting concentrated solutions with additional moderator, and
   6. Introducing voids between rows of fuel assemblies or other discrete units of SNM in a storage array;

d. Changes in the neutron population fraction lost by absorption from:
   1. Losing solid absorber by corrosion or leaching,
   2. Losing moderator,
   3. Redistributing SNM and absorber material by precipitation of one of the materials from solution,
   4. Failing to add intended amount or distribution of absorber material,
   5. Miscalculating the correct amounts or concentrations;

e. Changing the neutron reflection from:
   1. Adding or changing reflector material (e.g., water or personnel),
   2. Changing the reflector composition by causing loss of absorber (e.g., from corrosion of an outer casing of absorber)
   3. Changing reflection barrier locations;

f. Changing the neutron interaction between units and reflectors from:
   1. Introducing additional units or reflectors (e.g., personnel),
   2. Improperly placing units,
   3. Losing moderator and absorber between units,
   4. Collapsing the framework used for spacing the units,

g. Increasing the density of SNM.

5. Considerations for "No Decrease In Effectiveness" Changes:

Comment: The requirements of this section are inconsistent with provisions in draft rule sections §70.60 and 70.72 (as modified to include NEI comments). This section discusses an NCS program change procedure that is not consistent with the proposed §70.72 change procedure and adds a "decrease in effectiveness" criterion not contained in the draft rule revisions. This section must be brought into compliance with the proposed rule revisions.

The applicant commits that any change in the NCS program, including a change to structures,

~~systems, equipment, components, and activities of personnel relied on for safety, will be evaluated by the applicant to determine whether the change increases the risk of an accident at the facility, including decreases in the effectiveness of the applicant's NCS program. The applicant has stated that the evaluation will be based on the applicant's ISA and other pertinent NCS information.~~

~~The proposed change is acceptable, without prior approval, if it does not increase significantly the risk of an accident at the facility. In particular, the change must satisfy the following criteria:~~

a. ~~Does not significantly increase the likelihood or consequences of an accident previously evaluated in the ISA. This includes that there be no significant increase in the likelihood or consequences of a malfunction of equipment relied on for safety, nor significant degradation of procedures relied on for safety.~~ Comment: this provision would require a licensee to commit to license amendments any time a proposed change in plant design involves any of the following "…*new types of malfunction or items relied on for safety, new types of potential failures, use of new types of equipment… or the use of existing types of equipment in new processes*…" This new and excessive requirement would severely limit the capability of licensees to make safety improvements without first acquiring NRC approval. This is inadvisable as it will result in a large increase in the number of requested license amendments.

b. ~~Does not create the possibility for an accident of a type different from any previously evaluated in the ISA. This includes new types of malfunction of equipment relied on for safety, new types of procedural failures, use of new types of equipment or procedures relied on for safety, or the use of existing types in new types of processes, and changes that would create the possibility of accidents having consequences of concern not previously identified as possible in that type of process.~~

~~The term "significant increase" as used in the rule means:~~

a. ~~For consequences: An increase in the consequences of an identified accident that would place it in the next higher level of consequences as defined in 10 CFR 70.60(b) or a numerical increase by a factor of 3 or greater, if the previous consequences were already at the highest level;~~

b. ~~For likelihood: If the safety performance indexing method of SRP Chapter 3 is used, any change that increases the value of the any of the indices used in evaluating any accident. This means that the change is significant if it increases by more than a factor of three the likelihood, frequency, or duration of failure of any item relied on for safety. In particular, changes of safety controls from passive engineered to active, or from active to enhanced administrative, or from enhanced administrative to purely administrative, would be considered significant. Offsetting increases in failure likelihood of a control by improvements in a different control, and performance of the change by an accumulation of a sequence of minor changes, do not obviate the fact that a significant change in likelihood has occurred requiring prior approval.~~

Comment: there will be problems in the definition of what constitutes a "*significant increase*" in consequences or likelihood (such that prior NRC approval would be required), including the presumption that changes from "passive engineered" controls to "active engineered" controls would result in a significant increase in risk.

6. **Requirements for "Decrease in Effectiveness" Changes**: The applicant commits that any change in the NCS program that decreases the effectiveness of the applicant's NCS program will not be implemented without a license amendment application and prior NRC approval. As part of the license amendment application, the applicant will update the ISA to reflect the change and submit any revisions of the license application to the NRC for approval.

The following two items (7) and (8) should be eliminated because they are covered by sections 5.4.5.2 and 5.4.5.3 as referenced.

7. **Safety Margin Requirements for Processes Using Controls and Controlled Parameters**: A sufficient margin of safety exists for processes that could lead to an inadvertent nuclear criticality as evidenced by the use of controls and controlled parameters in accordance with the acceptance criteria of SRP Section 5.4.5.2, "NCS Limits."

8. **Requirements for Controlled Parameters and Controls**: If the safety basis relies on specific controlled parameters, then the use of these controlled parameters meets the acceptance criteria of SRP Section 5.4.5.3, "NCS Controlled Parameters." If the safety basis relies on specific controls, then these controls are established such that the controlled parameters associated with these controls also meet these acceptance criteria.

5.4.5.2 NCS Limits

Comment: This section requires the licensee to establish three levels of criticality safety limits: failure limits, safety limits and operating limits. Determining *failure limits* requires finding precisely where a component or array of components reaches K_{eff} = 1.0 minus the calculational bias. This is a very time-consuming process and does nothing to increase the safety of an operation. Determining *safety limits* requires determination of the maximum change that can occur with the controlled parameter. The safety limit is the failure limit minus three times the maximum change in the control limit. For example, if a parameter value of 100 represents the failure limit and the parameter can be controlled to ±5% of the value, the maximum safety limit would be 85. This section also states that in no case could the safety limit ever be more than 95% of the failure limit for a controlled parameter. *Operating limits* must not exceed 85% of the safety limit. This section is inconsistent with the concepts of assuming equivalent safety and risk control regardless of the bias (experimental criticality data or validated analytical method) for a sub-critical limit.

The development of NCS limits for controls and controlled parameters is acceptable if the following criteria are met:

1. **Assumptions Used for Developing Nuclear Criticality Safety Limits on Controlled Parameters**: Optimum conditions (i.e., most reactive conditions) are assumed for each parameter unless specified and acceptable controls are implemented to limit the parameters to certain values. For example, development of nuclear criticality safety limits assumes optimum moderation, full reflection, and a conservative process density, unless controls are implemented that meet the acceptance criteria for moderation (SRP Section 5.4.5.3.6), reflection (SRP Section 5.4.5.3.5), and density (SRP Section 5.4.5.3.3), respectively. Comment: This section requires that "optimum conditions" be assumed in criticality analyses unless acceptable controls are implemented to preclude such conditions. This requirement appears excessive, if optimum conditions are not realistic.

2. **Derivations of Nuclear Criticality Safety Limits on Controlled Parameters**: Nuclear criticality safety limits are derived from either (1) experimental data published in applicable ANSI standards or in industry-accepted handbooks or (2) validated analytical methods in accordance with the acceptance criteria for analytical methods (SRP Section 5.4.5.4, "Analytical Methods").

3. **Consideration of Heterogeneous Effects**: Heterogeneous effects are considered in deriving nuclear criticality safety limits. Heterogeneous effects are particularly relevant to deriving nuclear criticality safety limits for low-enriched uranium processes, where heterogeneous systems are more reactive than homogeneous systems for all other parameters being equal.

4. **Development of Failure Limits**: Subcritical ~~Failure~~ limits for all k_{eff} calculations are established at a value such that the failure limit $k_{failure}$ = 1.0 - bias. The bias, as defined in ANSI/ANS-8.1, ~~"Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors~~," is a measure of the systematic disagreement between the results calculated by a computational method and experimental data. The uncertainty in the bias (due to uncertainties in the precision of the calculation and the accuracy of the experimental data) is included when calculating the bias. Comment: section should be re-written to use wording that is consistent with §70.60(d)

5. Comment: Item 5 is far too prescriptive and should be entirely deleted. The method prescribed for calculating the bases for nuclear criticality limits is too restrictive. ANSI/ANS-8.1 allows that there are "…*many calculational methods [that are] suitable for determining the effective multiplication factor*…" (ANSI/ANS-8.1 §4.3) While the licensees agree that License Limits (normal operations) and failure limits (Keff = 1.0 + bias & uncertainties) must be established, it should be left to the licensees to provide in the application and lower-tier documents to establish methods for calculating and/or setting these limits.

   ~~**Bases for Nuclear Criticality Safety Limits**: Nuclear criticality safety limits are established using one of the following depending on whether the limits are based on experimental data or on results from validated analytical methods:~~

a. Limits Based on Experimental Data:

Controlled Parameters: When using experimental data, the applicant applies industry-accepted safety factors for NCS limits on controlled parameters as follows. When double batching is possible, the mass is limited to no more than 45 percent of the minimum critical mass based on spherical geometry; when double batching is not possible, the mass is limited to no more than 75 percent of the critical mass. Acceptable margins of safety on geometry for large single units are 90 percent of the minimum critical cylinder diameter, 85 percent of the minimum critical slab thickness, and 75 percent of the minimum critical sphere volume. Comment: The stated safety factors (45%, 75%, etc.) are **not** adopted in ANSI/ANS-8 and are **not** "industry-accepted". Where did these numbers come from?

Favorable cylinder diameters, slab thicknesses, unit masses, and volumes may be tabulated in the application as a function of moderation, enrichment, reflection, etc.

Controls: Controls and their setpoints associated with controlled parameters are established to ensure these controlled parameter safety limits are not exceeded.

b. Limits Based on Results from Validated Analytical Methods:

Controlled Parameters:

1. When using results from validated analytical methods, the establishment of the safety limit for a controlled parameter relies on the ability to control the parameter at that safety limit so that the controlled parameter remains below the failure limit.

2. The failure limit for a controlled parameter is equal to the value of the parameter at which $k_{eff} = k_{failure}$.

3. For each controlled parameter, a determination of the correlation between k_{eff} and variations in the parameter is made. This correlation along with an assessment of the measurement uncertainty for the controlled parameter and the ability to detect and control process variations that affect the controlled parameter is used to establish adequate safety margins.

4. If a controlled parameter can be demonstrated to be reliably controlled (i.e., to a 95% confidence level) to some maximum change in value that increases k_{eff}, then the controlled parameter safety limit is less than the failure limit by a factor of three times this maximum change (e.g., if a parameter can be controlled to increase by no more than 5 percent of the failure limit, then the safety limit is below the failure limit by a factor of three times this controlled increase, or 85 percent of the failure limit).

5. A controlled parameter safety limit is not established that exceeds 95 percent

of the failure limit for a controlled parameter.

6. Operating limits are established to ensure that safety limits associated with nuclear criticality safety are not exceeded.

7. A controlled parameter operating limit is not established that exceeds 85 percent of the safety limit Comment: An operating limit that must be 85% of the safety limit is too prescriptive. Rather the licensee should set this limit below the safety limit to account for process variability and measurement uncertainty. In many circumstances this requirement is too restrictive, while in other circumstances it may be inadequate. This statement would be true for both controlled parameters and controls.

Controls:

1. In those cases using results from validated analytical methods where the safety basis relies on a control, the establishment of the control safety limit requires the ability to operate the control at that safety limit so that the control remains below the failure limit.

2. The failure limit for a control is equal to the value of the control at which k_{eff} = $k_{failure}$.

3. For each controlled parameter, a determination of the correlation between k_{eff} and variations in the parameter is made. This correlation along with an assessment of the measurement uncertainty for the controlled parameter and the ability to detect and control process variations that affect the controlled parameter is used to establish adequate safety margins.

4. If a control can be demonstrated to be reliably operated (i.e., to a 95% confidence level) to some maximum change in value that increases k_{eff}, then the control safety limit is less than the failure limit by a factor of three times this maximum change (e.g., if a control can be controlled to increase by no more than 5 percent of the failure limit, then the safety limit is below the failure limit by a factor of three times this controlled increase, or 85 percent of the failure limit).

5. A control safety limit is not established that exceeds 95 percent of the failure limit for a control.

6. Operating setpoints of controls are established to ensure that control safety limits are not exceeded.

7. A control operating setpoint is not established that exceeds 85 percent of the value of the controlled safety limit.

6. **Evaluation of Nuclear Interaction**: The nuclear interaction of adjacent units is evaluated in accordance with the acceptance criteria in SRP Section 5.4.5.3.8. Comment: Item (6) is redundant and has already been included in items (1) and

(10). Item (6) is, therefore, deleted.

7. ~~Operating limits and setpoints are established in operating procedures.~~
Comment: Item (7) is not criticality safety related and should be deleted. Furthermore, this item will require that all controls, controlled parameters and their set points be specified in operating procedures. This requirement is unreasonable and counter to good operating practice. An operator cannot control many controlled parameters – adding superfluous information to procedures detracts from important matters in controlling a process. This requirement is excessive and counter-productive.

8. ~~All controls and controlled parameters and their associated safety limits are specified in operating procedures.~~ Comment: Item (8) is inappropriate as an operating procedure and should be deleted.

9. **Techniques for NCS Control**: Where practicable, reliance is placed on equipment design that uses passive-engineered controls rather than on administrative controls. The following give techniques for NCS control, listed in the order of preference: Comment: the following four definitions should be relocated to an SRP "Definitions" chapter.

   a. Passive-Engineered Controls: These controls use fixed design features or devices. No human intervention is required except maintenance and inspection.

   b. Active-Engineered Controls: These controls use active hardware to sense parameters and automatically secure the system to a safe condition. Operations of these controls require no human intervention.

   c. Augmented Administrative Controls: These controls rely on human judgment, training, and actions for implementation but use warning devices (visual or audible) that require specific human actions to occur before the process can proceed to augment the implementation of the controls.

   d. Simple Administrative Controls: These controls rely solely on human judgment, training, and actions for implementation.

10. Parameters for ~~**Methods of**~~ **NCS Control** ~~**(Controlled Parameters)**:~~ Several methods of NCS control are available (i.e., controlled parameters). Controlled parameters available for NCS control include, but are not limited to, the following:

   a. Mass
   b. Geometry
   c. Density
   d. Enrichment
   e. Reflection
   f. Moderation
   g. Concentration
   h. Interaction
   I. Neutron Absorber (e.g., boron)

j. Volume
k. Process Variables (i.e., temperature, pH, etc.)
l. Instrumentation

Comment: Delete item (11) as it redundant with item (9). As a practice, the most reliable, feasible controls are used. Demonstrating this fact and including the bases for the selection of parameters to control and the types of controls used – putting all of this information in the license application – is an excessive requirement that does nothing to increase safety.

11. Controlled parameters and feasible techniques for controlling them are established based on the results of the ISA. ~~As such, to minimize the risks from initiating an inadvertent nuclear criticality, the highest order technique is used for controlling a specific controlled parameter (i.e., method of NCS control) that provides for double contingency protection. If using the highest order technique is not feasible or the ISA does not support its use, then lower order techniques may be used with adequate justification that there is no decrease in effectiveness for the safety basis. Adequate justification includes the following:~~

~~a. Feasibility is determined by weighing risk versus either practicality or cost.~~

~~b. The basis for not selecting geometry control is fully documented.~~

5.4.5.3 NCS Controlled Parameters

Comment: this §5.4.5.3 is the one area of Chapter 5 where an greater level of prescriptiveness may be appropriate, as nuclear science clearly dictates how each NCS Control parameter can be reliably used.

5.4.5.3.1 Mass

The use of mass as a criticality controlled parameter is acceptable if the following criteria are met:

1. Safety limits are developed and used in accordance with the acceptance criteria for NCS limits.

2. One of the following methods is used:

   a. A percentage factor is used to determine the percentage of SNM of a given mass of material. In this case, the applicant ensures that the acceptance criteria in SRP Section 5.4.5.3.11, "Using Process Variables as a Criticality Control," are met.

   b. Fixed geometric devices are used to limit SNM. A conservative process density is used unless the acceptance criteria for establishing density controls are met (SRP Section 5.4.5.3.3).

   c. The mass is measured, assuming all the material is SNM, using an instrument that meets the acceptance criteria for instrumentation (SRP Section 5.4.5.3.12).

5.4.5.3.2 Geometry

The use of geometry as a criticality controlled parameter is acceptable if the following criteria are met:

1. Safety limits are developed and used in accordance with the acceptance criteria for NCS limits.

2. A mechanical evaluation is performed demonstrating that geometry will be maintained under both normal operating conditions and credible abnormal conditions. Comment: this requirement is not necessary – too prescriptive.

3. All dimensions and nuclear properties on which reliance is placed are verified before beginning operations, and controls are exercised to maintain these dimensions and nuclear properties.

5.4.5.3.3 Density

The use of density as a criticality controlled parameter is acceptable if the following criteria are met:

1. Safety limits are developed and used in accordance with the acceptance criteria for NCS limits.

2. Process variables that may affect the density are controlled in accordance with the acceptance criteria for using a process variable as a criticality control (SRP Section 5.4.5.3.11, "Using Process Variables as a Criticality Control").

3. A physical measurement of the density is obtained by instrumentation that meets the acceptance criteria for instrumentation (SRP Section 5.4.5.3.12). Comment: there is no need to measure density, for in the NCS evaluations theoretical densities of fissile material compounds were used. Unnecessary request in the SRP.

5.4.5.3.4 Enrichment

The use of enrichment as a criticality controlled parameter is acceptable if the following criteria are met:

1. Safety limits are developed and used in accordance with the acceptance criteria for NCS limits.

2. A physical measurement of the enrichment is obtained by instrumentation that meets the acceptance criteria for instrumentation (SRP Section 5.4.5.3.12).

3. A method of segregating enrichments is used to ensure differing enrichments will not be interchanged without violating the double-contingency principle.

5.4.5.3.5 Reflection

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The use of restrictions to control reflection of a unit is acceptable if the following criteria are met:

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

2. The wall thickness of the unit plus all reflecting adjacent materials are considered in the evaluation.

3. Adjacent materials are farther than 1 foot away from the unit.

4. Potential reflectors (other than the unit wall and adjacent materials specified in Criteria 2 and 3 above) are identified and engineered and/or administrative controls are established to exclude them. Comment: this item is too prescriptive. The SRP should allow the licensee to identify potential reflectors and then account for them in appropriate supporting analyses.

5. Positive and testable personnel barriers are established and maintained through the configuration management and maintenance programs of the facility. Comment: this item is too prescriptive and too restrictive if safety evaluation accounts for personnel.

5.4.5.3.6 Moderation

The use of moderation as a criticality controlled parameter is acceptable if the following criteria are met:

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

2. One or more of the following methods are used to restrict or measure moderation:

   a. A physical measurement of the moderation is obtained by instrumentation that meets the acceptance criteria in SRP Section 5.4.5.3.12, “Instrumentation Used for Criticality Control.”

   b. Process variables that may affect the moderation are controlled in accordance with the acceptance criteria for using a process variable as a criticality control (SRP Section 5.4.5.3.11 "Using Process Variables as a Criticality Control").

   c. Physical structures are designed and demonstrated to preclude the ingress of moderators.

   d. Sampling programs use dual sampling techniques and require authorization of a supervisor before material is released.

3. Restrictions on the use of hydrogenous material for firefighting activities are established. Note that the ISA may weigh the competing risks and override this

element.

4. 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.

5.4.5.3.6 Concentration

The use of concentration as a criticality controlled parameter is acceptable if the following criteria are met:

1. High concentrations are precluded solubility limits and the solubility limits of the SNM are demonstrated.

2. Process variables that may affect the solubility are evaluated and controlled in accordance with the acceptance criteria for using process variables as a criticality control (SRP Section 5.4.5.3.11).

3. Possible precipitating agents are identified to the operators through procedures and appropriate precautions are taken to ensure that such agents are not introduced.

4. A positive means of preventing inadvertent transfers is provided if a possibility exists for precipitating agents to be transferred by way of connected processes. (The mechanisms evaluated for possible inadvertent transfer are mechanical, chemical, and/or thermal energies.)

5. Concentration safety limits are established using experimental data or are derived from validated analytical methods in accordance with the acceptance criteria for analytical methods.

6. Concentration safety limits are established in accordance with the acceptance criteria for NCS limits of controlled parameters (SRP Section 5.4.5.2).

7. Adequate controls are in place to control the quantity of the precipitating agent or the change in the process variable (i.e., pH and temperature) that would be necessary to over concentrate the solution.

8. Full reflection is used in deriving the appropriate limits unless controls are implemented that meet the acceptance criteria for reflection (SRP Section 5.4.5.3.5).

9. Tanks containing solution remain normally closed. Supervisory personnel are required to supervise operators when tanks are opened. Comment: if this item requires supervisors to be physically present during this operation, it is unacceptably prescriptive and restrictive.

10. Sampling programs to measure concentration use dual sampling and require supervisory approval before transferring solution.

11. Instrumentation used to measure the concentration meets the acceptance criteria for instrumentation in SRP Section 5.4.5.3.12.

5.4.5.3.8 Interaction

Demonstration that neutron interaction between units is acceptable if the following criteria are met:

1. The minimum spacing between units is evaluated and controlled using the acceptance criteria for geometric devices (SRP Section 5.4.5.3.2) and the following methods:

    a. Engineered devices (spacers) maintain physical separation between units. These devices, racks, and other equipment are intended to ensure that spacing requirements meet the safety-related requirements of the appropriate construction standard.

    b. Unit spacing is controlled by rigorous procedures (if the spacing is identified in workstation procedures with visual indicators and postings).

2. Sensitivity studies are conducted to ensure that controls in place can prevent unacceptable dimensional changes that would lead to an inadvertent nuclear criticality.

3. Sensitivity studies are conducted to ensure that controls in place will prevent unacceptable changes in assumed reflection and moderation conditions from leading to an inadvertent nuclear criticality. These studies conservatively model credible reflection conditions in and around arrays to bound any credible accident conditions from exceeding facility safety limits for high and intermediate risk sequences.

4. The structural integrity of spacers (if used) is sufficient for normal conditions, abnormal conditions (e.g., overloading), and accident conditions (e.g., fires).

5.4.5.3.9 Neutron Absorber

The use of a neutron absorber as a criticality controlled parameter is acceptable if the following criteria are met:

1. Safety limits are developed and used in accordance with the acceptance criteria for NCS limits.

2. The requirements of ANSI/ANS-8.5 are fulfilled when using borosilicate-glass Raschig rings. Comment: Adherence to all requirements in ANSI/ANS-8.5 has not been necessary at every fuel cycle facility; this is a facility-dependent issue.

3. Procedures are established to ensure that the neutron absorber is effective in the system of its proposed use.

4. Procedures are established to verify the presence and continuing effectiveness of fixed neutron absorbers before use and periodically thereafter.

5.Controls are exercised to maintain the continued presence and the intended distribution and concentration of fixed neutron absorbers.

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

7.The requirements of ANSI/ANS-8.21 are fulfilled when using fixed neutron absorbers. Comment: Adherence to all requirements in ANSI/ANS-8.21 has not been necessary at every fuel cycle facility; this is a facility-dependent issue.

5.4.5.3.10 Volume

The use of volume as a criticality controlled parameter is acceptable if the following criteria are met:

1.Safety limits are developed and used in accordance with the acceptance criteria for NCS limits.

2.The following methods are used:

a. Geometrical devices restrict the volume of SNM (see acceptance criteria for geometry, SRP Section 5.4.5.3.2).

b. Engineered devices or instrumentation limit the accumulation of SNM. In this case, the acceptance criteria for instrumentation are met (SRP Section 5.4.5.3.12).

5.4.5.3.11 Using Process Variables as a Criticality Control

Comment: This section requires details on the correlation of process parameters to K_{eff} (e.g. how the relation of processing temperature to powder moisture content affects K_{eff}). Such correlation may not be known, even though values for which a significant safety margin of subcriticality are known. This is a new requirement that is excessive and that does not contribute to an increase in safety. The use of a process variable as a criticality control is acceptable if the following criteria are met:

1.Process variable safety limits are established to correspond to applicable controlled parameter safety limits in accordance with the acceptance criteria for NCS limits of controlled parameters (SRP Section 5.4.5.2).

2.Performance testing is conducted at a specified frequency for the controls to ensure nuclear criticality safety limits are not exceeded.

3.Training programs are conducted to ensure that affected plant personnel understand the nuclear criticality safety limits.

5.4.5.3.12 Instrumentation Used for Criticality Control

Instrumentation used for criticality control is considered acceptable if the following criteria are met:

1. Instrumentation is calibrated at a specified frequency and is demonstrated to be capable of functioning as designed within manufacturer specifications and ensuring that a safety margin is not exceeded.

2. The sensitivity of the instrumentation is demonstrated to be sufficient.

3. The control system in which the instrument output is used can safely terminate the process.

5.4.5.4 Analytical Methods

~~The use of a~~Analytical methods to calculate~~ nuclear criticality safety limits~~ system K_{eff} ~~is~~ are acceptable if the following criteria are met:

1. The method is described with sufficient detail and clarity to allow independent duplication of results.

2. Nuclear data (e.g., cross-sections) are demonstrated to be consistent with reliable experimental measurements.

3. Plant-relevant benchmark experiments and data derived therefrom for the validation effort (e.g., composition, enrichment, geometric configuration, and nuclear properties including reflectors, absorbers, and moderators) are used in the analysis.

4. The mathematical operations are verified to function properly (i.e., calculation of k_{eff} values by way of the calculational method from data in Criterion 2 and comparison to experimental k_{eff} values (typically at a k_{eff} value of 1.0)). Comment: Does this item mean "verification"?

5. The area of applicability, typically spanning the range of parameters in the experiments (e.g., enrichment, moderation, reflection, neutron absorbers), is assumed and determined in accordance with ANSI/ANS-8.1. The area of applicability is the range of material compositions and geometric arrangements within which the bias of a calculation method is established. Any extrapolation beyond the range of experiments is supported by a reliable and scrutable basis.

6. The bias, the prescribed margin of subcriticality over the area of applicability, and the basis for the margin are calculated and described. The margin of subcriticality includes allowances for the uncertainty in the bias.

7. Uncertainties in the analytical method (e.g., due to statistics, computational convergence, nuclear cross-section data) and uncertainties in the benchmark experiments are estimated and considered in the analysis.

8. Software management measures and ~~quality assurance and~~ configuration

management on the nuclear data and calculational method are specified.

9. The validation of the analytical method (Cratriaiteria 1–8 above) is documented according to ANSI/ANS-8.1 and ANSI/ANS-8.17, and the documentation is maintained. in the facility's configuration management program.

5.4.5.5 Criticality Accident Alarm System

Comment: this section should simply reference Reg. Guide 3.71 (sections in the old 8.12). Requirements which expand upon 3.71 are inappropriate. Repetition of 3.71 is unnecessary. Some requirements in this section are too prescriptive and may not be justifiable by the results of the ISA. For example, there is no justification in the rule to demand of a licensee: (i) seismically and environmentally-qualified criticality alarms, (ii) two detectors/area, (iii) emergency power for detectors, (iv) uniform detection systems, etc. Furthermore, a licensee must await the results of the ISA to see if a nuclear criticality could not occur, thereby exempting the facility from the need of a criticality alarm system. This section runs counter to the requirements of 10 CFR 70.24.

The criticality accident alarm system is considered acceptable if the elements contained in ANSI/ANS-8.3 are implemented and the following criteria are met:

1. The applicant demonstrates criticality alarm system coverage for all systems and activities (e.g., processing, storage, handling) that the ISA identifies as potential nuclear criticality hazards.

2. In areas requiring criticality alarm coverage, excessive radiation dose rates are reliably detected and audible alarms are signaled for conditions requiring the necessity for personnel evacuation. Analyses are provided to demonstrate that the detector can adequately and reliably detect an inadvertent nuclear criticality at the points where criticality monitoring instrumentation is placed. 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.

3. Emergency plans are maintained where alarm systems are installed.

4. The system is uniform throughout for the type of radiation detected, the mode of detection, the alarm signal, the system dependability, and the design criteria per ANSI/ANS-8.3.

5. Alarms are designed to remain operational in case of a seismic shock equivalent to the site-specific design-basis earthquake, or the equivalent value specified by the Uniform Building Code.

6. Alarms are designed and installed to remain operational in case of fire, explosion, corrosive atmosphere, or other extreme conditions (e.g., in the environment caused by a particular accident).

7. An alarm is clearly audible in all areas that must be evacuated.

8. The system has provisions to minimize false alarms.

9. ~~Approved procedures are implemented for calibrating instrumentation, testing (individual detectors and the entire system), and documenting the results; these procedures are embedded in the configuration management system.~~

10. ~~The system can detect a nuclear criticality that produces a neutron-plus-gamma absorbed dose of 20 rads in soft tissue at an unshielded distance of 2 meters within one minute. In accordance with Regulatory Guide 8.12, "*Criticality Accident Alarm System*," this criterion is in contrast to the criterion in ANSI/ANS-8.3, which requires detection of the dose in free air instead of in soft tissue.~~

11. ~~The applicant provides fixed and personnel accident dosimeters in areas that require criticality alarm systems and a method for prompt, onsite dosimeter readouts. These dosimeters are placed to be readily available to personnel responding to an emergency as the result of a nuclear criticality accident.~~

12. ~~Formal training is required for personnel to recognize the criticality alarm signal and to evacuate promptly to a safe area.~~

13. ~~The effects of shielding and geometry are considered in a demonstration of the adequacy of the alarms to detect a nuclear criticality.~~

14. ~~Emergency power is provided for installed accident monitoring systems.~~

15. ~~The licensee commits to rendering operations safe, by shutdown and quarantine if necessary, in any area where criticality alarm coverage has been lost and not restored within a specified number of hours. The number of hours will be determined with the reviewer on a process by process basis because interfering with 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 a clearly a fairly small risk.~~

5.4.6 ISA Results

Comment: Move the contents of this section to SRP Chapter 3.0, consolidate and remove redundancies and inconsistencies and reference the reviewer to that chapter. This section needs to be entirely rewritten. Attempts to quantify "*unlikely*" through probabilistic means are totally inappropriate and are not in accordance with ANS Guidance. Attempts to quantify '*unlikely*' and '*highly unlikely*' are inconsistent with the approach discussed at the January 13th, 1998 public meeting on NCS with NRC. [The language in this §5.4.6 has not been thoroughly reviewed, pending relocation to SRP Chapter 3.0]

The only consequence applicable to NCS is an inadvertent nuclear criticality, which is one of the highest consequences of concern as specified in Section 70.60(b)(1) of 10 CFR Part 70. Comment: a nuclear criticality is no longer singled out as a "high consequence of concern". This language must be corrected.

Corresponding to this consequence category, Section 70.60 requires graded protection to ensure that the likelihood of a nuclear criticality is correspondingly low. The three categories of likelihood thus prescribed are:

a. Likelihood Category 1: "highly unlikely,"
b. Likelihood Category 2: "unlikely," and
c. Likelihood Category 3: not unlikely

A major purpose of the ISA is to show compliance with the above system of graded protection. This can be done using a tabular summary of identified accidents. One acceptable way of doing so is for the applicant to assign the above numerical values to each accident sequence in accordance with its consequences and likelihood and then to calculate the product of the two numbers as a risk index. This calculated risk index should then be listed in the tabular summary of accidents described in SRP Chapter 3.0, "Integrated Safety Analysis." Accidents resulting in risk indices less than or equal to 4 are acceptable. This system is equivalent to assigning each accident to a cell in the following risk matrix, according to SRP Chapter 3.0, Appendix A.

RISK MATRIX*

(**The values in the matrix cells below are the risk index numbers, equal to the product of the consequence and likelihood category numbers.*)

	Likelihood Category 1	Likelihood Category 2	Likelihood Category 3
Consequence Cat. 3	3 Acceptable	6 Unacceptable	9 Unacceptable
Consequence Cat. 2	2 Acceptable	4 Acceptable	6 Unacceptable
Consequence Cat. 1	1 Acceptable	2 Acceptable	3 Acceptable

Therefore, because criticalities are automatically considered consequence category 3, the ISA should ensure that any accident sequence leading to a nuclear criticality has a likelihood category of 1 (i.e., "highly unlikely"). Comment: this assumption must be corrected "…*because criticalities are automatically considered consequence category 3…*"

The nuclear criticality aspects of the applicant's ISA are acceptable if the following criteria are met:

1. The applicant conducts and maintains an ISA that identifies specific control parameters or specific controls necessary for the prevention of an inadvertent nuclear criticality from specified accident sequences. These sequences consider fire, loss of electrical services, and other potential common mode failures.

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2. The measures taken by the applicant to ensure adequate design, specification, procurement, installation, maintenance, and operation of these controls are specified.

3. The applicant commits to appropriate levels of management measures ~~quality assurance~~, configuration management, training, and maintenance to ensure continued availability and reliability of the controls important to safety.

4. The frequencies of initiating events are sufficiently low and the reliability of safety controls involved are sufficiently high so that accident sequences that could result in a criticality are "highly unlikely."

5. Determining whether an accident is "highly unlikely" or "unlikely" is accomplished by the criteria of SRP Chapter 3.0, Appendix A, where frequencies less than10^{-5} per year per accident are considered "highly unlikely" and frequencies less than 10^{-2} per year per accident are considered "unlikely." Comment: delete the quantitative measures in this item (5) and other subsequent items to be consistent with ANSI/ANS-8.1

6. The double contingency principle or its exception with adequate justification is adhered to as specified in SRP Section 5.4.5.1, "Criticality Safety Evaluations."

7. The following additional criteria regarding the adequacy of the likelihood of control failures as defined in SRP Chapter 3.0, Appendix A, are met:

   a. At least one of the two controlled parameters or controls required to prevent a nuclear criticality has a failure frequency index or failure probability index of less than or equal to "-3" (i.e., 10^{-3} failures per year), so that an inadvertent nuclear criticality will be "highly unlikely" when adding the indices for either (1) the two controlled parameters required for double contingency or (2) the two controls required for its exception.

   b. The other controlled parameter or control has a failure frequency index or failure probability index of less than or equal to " -2 " (i.e., 10^{-2} failures per year).

   c. The failure duration index is assumed no less than "-1" (i.e., 0.1 years or ~1 month) unless adequate justification is provided to demonstrate a less conservative (i.e., more negative) index is appropriate. [Note: the failure duration index provides an indication of the estimated time it will take to discover and repair a control or controlled parameter. Therefore, it is important that this index reflects reality at the facility so that a conservative estimate of the risk can be determined. Even if adequate justification is provided, the reviewer ensures that without taking credit for a more negative failure duration index, the likelihood index is still less than or equal to "-5 "; if it is greater than "-5 ", then increased focus should be given to the NCS of the relevant accident sequence.]

   d. The likelihood index (i.e., total of the failure frequency, failure probability, and failure duration indices) is less than or equal to "-5 " (i.e., 10^{-5} per year per accident).

5.5 PROCEDURES FOR REVIEW

Comment: Prior to starting review of a license application, the NRC reviewer should refresh his familiarity with the ANSI/ANS-8 standards.

5.5.1 Acceptance Review

Comment: this section should be revised to reflect changes in Acceptance Criteria outlined earlier in this red-lined version of Chapter 5.

The primary reviewer should review the applicant's NCS information for completeness against the acceptance criteria in Section 5.4. If deficiencies are identified, the applicant should be requested to submit additional material before the start of the safety evaluation.

5.5.2 Safety Evaluation

Comment: this section implies (or directs) a level of review of process--specific safety information that is beyond the scope of the license application review process. Selected reviews of information may be appropriate during licensing visits to a facility. Compliance with license commitments is a function of operational reviews and inspections.

1. To initiate the NCS review of the application, the reviewing staff should first examine the process description and walk down the process lines, to the extent possible, to gain familiarity with the plant processes, if the facility exists.

2. Comment: item 2 requires a level of process review that cannot be done using the ISA Summary by a single reviewer outside of the context of the ISA process in the plant.

   The ISA is the fundamental component to both the applicant and the staff in reviewing the nuclear criticality safety of the facility. In addition, the ISA delineates the level of controls necessary to protect workers and public health and safety.

   The NCS reviewer will review the ISA summary in the application and identify those accident sequences that may potentially lead to a nuclear criticality. The reviewers will identify any additional credible sequences not identified in the ISA that have the potential for nuclear criticality and formulate questions concerning these accident sequences for the applicant in accordance with SRP Section 5.4.6. Comment: it is **impossible** for the reviewer to "…*identify any additional credible sequences not identified in the ISA [summary]*…"; this requirement would only prompt the reviewer to issue Requests for Additional Information! The reviewer should only be expected to check the application for gross omissions and focus on review of the higher risk accident sequences identified in the ISA Summary. The effects from fire, loss of electrical services, and other credible common mode failures on controls relied on for NCS will be reviewed. The reviewer will use the graded acceptance criteria in SRP

Section 5.4.6, "ISA Results." In addition, the reviewer will consider the number, type, and effectiveness of controls. Depending on the degree to which a control is relied upon (i.e., whether it is the only control or one of several), the management measures ~~control programs~~ associated with NCS will be appropriately graded to that specific control.

3. Comment: item 3 is an inspection activity that is not appropriate for a review of a license application.

   To ensure that the basis of safety is clearly stated, the staff will review the nuclear criticality safety chapter of the application and verify that the applicant has met the acceptance criteria in SRP Section 5.4.5.1, "Criticality Safety Evaluations." ~~The reviewer will use the input data provided by the applicant for those systems determined to have sufficient risk significance to perform confirmatory and sensitivity calculations.~~ Comment: the input data will only be available at the facility site for review; it is not in the license application.

4. Comment: Item 4 requires a level of process review that cannot be done by a single reviewer.

   The staff will then determine the adequacy of the controls used to preclude a nuclear criticality, if specific controlled parameters are used to form the basis of safety, by ensuring that the applicant has fulfilled the acceptance criteria of SRP Section 5.4.5.3, "NCS Controlled Parameters." Comment: The reviewer can not be expected to review the adequacy of the controls with the data that are supplied in the ISA Summary; this is an unrealistic expectation. In addition, to ensure that an acceptable margin of NCS is present, the staff will verify that the applicant has established adequate NCS ~~safety~~ limits for these controlled parameters in accordance with SRP Section 5.4.5.2, "NCS Limits." In the case where specific controls are used to form the basis of safety, the staff will ensure that the applicant has fulfilled the acceptance criteria for controls specified in SRP Section 5.4.5.2, "NCS Limits." ~~Finally, to ensure that the methods used to determine the safety margins are acceptable, the staff will verify that the applicant has used analytical methods in accordance with SRP Section 5.4.5.4, "Analytical Methods."~~

5. To ensure that the applicant has established an organization with the requisite responsibilities for implementing the NCS program, the staff will verify that the applicant has established positions with the responsibilities delineated in the acceptance criteria of SRP Section 5.4.3. In addition, the staff will ensure, in coordination with the management organization reviewer, that the applicant's organization includes those positions identified in SRP Section 5.4.3 in accordance with the acceptance criteria for SRP Section 2.0, "Organization and Administration." Comment: this information may have been transferred to SRP Chapter 11.

6. To ensure that documentation and record keeping are adequate as changes are made to the facility that may affect NCS, the staff will evaluate, in coordination with the configuration management reviewer, whether all elements affecting NCS are included in the applicant's configuration management program in accordance with

SRP Section 11.1. These elements include the process description, process and equipment design, as-built drawings, operating procedures, maintenance and testing of NCS control instruments, and NCS evaluations/limits. Comment: Item (6) requires that criticality safety analyses, ISAs, process descriptions, criticality code benchmarking and validation documents, code configuration control documents, as-built drawings, operating procedures, process and equipment design and maintenance and testing of NCS control instrumentation be included as part of the overall plant configuration control program. This also implies that these documents must be issued by document control. This requirement for so many documents does nothing to improve the facility's safety system. It is an excessive requirement that should be scaled back.

7. To ensure the operability of NCS controls, the staff will determine, in coordination with the principal reviewer of the maintenance program, that NCS controls are addressed in accordance with SRP Section 11.2, "Maintenance."

Item 8 ignores graded approach to implementation of management measures and incorrectly states that NCS controls must be of "….*the highest quality*…" It should be rewritten to be consistent with the proposed Rule revisions.

8. To ensure that the NCS controls are adequateof the highest quality for accident sequences that are anything other than highly unlikely, the reviewer will determine, in coordination with the management measures quality assurance reviewer, that the applicant has established a management measures quality assurance program, in accordance with SRP Section 11.3, that uses quality management measures assurance of the highest quality for the NCS controls proposed by the applicant, to ensure compliance with double contingency. In addition, the staff will verify that the applicant's management measures satisfy quality assurance satisfies the criteria in SRP Section 5.4.4.1.

9. 9. Item 9 -Replace SRP reference with 11.4.To ensure that operations involving humans are performed reliably and predictably, the staff will verify that the applicant has established an NCS training program in accordance with SRP Section 5.4.4.2 (Comment: now SRP Chapter 11.4). In addition, the staff will determine, in coordination with the training program reviewer, that NCS training is appropriately included in a performance-based training in accordance with SRP Section 11.4, "Training and Qualification."

10. To ensure that any NCS deficiencies that may arise are detected promptly, the staff will verify that the applicant has implemented procedures for operational inspections, audits, assessments, and investigations in accordance with SRP Section 5.4.4.3. In addition, the staff will determine, in coordination with the principal reviewer of the operational inspections, audits, etc., that the elements identified in SRP Section 5.4.4.3 are addressed by the applicant in accordance with SRP Sections 11.7, "Audits and Assessments," and 11.8, "Incident Investigations."

11. The staff will ensure, in conjunction with the principal reviewer of the applicant's operating procedures, that the applicant has established NCS operating procedures in accordance with SRP Section 11.5, "Procedures."

12. The staff will verify that the applicant has implemented acceptable emergency procedures for nuclear criticalities in accordance with SRP Chapter 8.0, "Emergency Management."

13. To ensure that personnel are alerted in case of an inadvertent nuclear criticality, the staff will verify that the applicant has met the acceptance criteria of SRP Section 5.4.5.5, "Criticality Accident Alarm System."

14. Comment: Item 14 should be deleted as it is inapplicable in the license review process. It belongs in inspection plans. This item erroneously presupposes that an NCS review will be maintained for *every* operation in the ISA. This is incorrect and would be prohibitively expensive to do ~~The reviewer will determine that the applicant conducts and maintains an NCS review of the ISA that includes a review of the identified potential accident sequences that result in an inadvertent nuclear criticality. The reviewer ensures that the specific controls or barriers relied on for NCS provide reasonable assurance that the controls will prevent a nuclear criticality accident. The reviewer will also evaluate those provisions that ensure that the specified NCS controls receive the required levels of maintenance and quality assurance, that appropriate training in their operation is provided, that adequate procedures are created and followed, and that the controls are managed within the facility's configuration management program.~~

The NRC staff will consult with NRC inspection staff to identify any systematic weaknesses in the applicant's program and consider these weaknesses during the review. Comment: the staff may also want to consult 91-01 and 70.50 reports in connection with the review of a license renewal application.

The review is concluded by documenting the findings according to SRP Section 5.6.

5.5.3 Requests for Additional Information

Delete this section as all requirements are already provided by regulation.
~~Based on its review, NRC staff may request that the applicant provide additional information or amend the submittal to provide reasonable assurance of nuclear criticality safety.~~

5.6 EVALUATION FINDINGS

The NRC staff verifies that the application provides sufficient information to satisfy 10 CFR Part 70 requirements and that the information satisfies the acceptance criteria in section 5.4 of this SRP. Based on the submitted information, the NRC staff will conclude that the evaluation is complete and that the review findings can be documented as follows:

Comments: "Improving" is **not** required by regulation. This term must be deleted from the language. Items (1) through (5) should also be deleted as they are redundant to the Acceptance Criteria.

The NRC staff has reviewed the applicant's proposed organization, management control systems, and technical program for developing, implementing, maintaining, and ~~improving~~ Nuclear Criticality Safety (NCS) according to Chapter 5 of the Standard Review Plan. ~~The staff has concluded that:~~

1. ~~The applicant has in place a staff of managers, supervisors, engineers, process operators, and other support personnel who are qualified to conduct the proposed operations according to approved NCS practices.~~
2. ~~The applicant's operational plans include NCS engineering and administrative practices that ensure that the fissile material will be possessed and used safely according to the requirements in 10 CFR Part 70.~~
3. ~~The NCS program is based on technical criteria and administrative practices such that the nuclear safety analyses ensure a safe basis for facility operation.~~
4. ~~SNM operations incorporate double contingency for NCS under normal operations and under credible accident conditions.~~
5. ~~The facility maintains a reliable criticality accident alarm system with corresponding emergency procedures.~~

Based on this review, the staff concludes that the applicant's plan for managing NCS and the NCS controls established to maintain safe operation of the facility meet the requirements of 10 CFR Part 70 and provide reasonable assurance that the health and safety of the workers and public are protected.

5.7 REFERENCES

Regulatory Guide 3.71, "Nuclear Criticality Safety Standards for Fuels and Materials Facilities (Draft DG-3013 published 1/98)

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

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