

# NRC INSPECTION MANUAL

NMSS

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## INSPECTION PROCEDURE 88020

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### REGIONAL NUCLEAR CRITICALITY SAFETY INSPECTION PROGRAM

PROGRAM APPLICABILITY: 2600 and 2630

#### 88020-01 INSPECTION OBJECTIVES

The objectives of the Region Nuclear Criticality Safety (NCS) Program inspection procedure are to ensure that:

01.01 The regulatee maintains an effective nuclear criticality safety program that has established configuration control over all facility and process operations that affect NCS.

01.02 The regulatee obtains and vigilantly implements NCS advice from a technical NCS function (NCSF) that acts independently from the production function.

01.03 The regulatee avoids undue risk of inadvertent criticality, i.e., the regulatee's activities are conducted safely.

#### 88020-02 INSPECTION REQUIREMENTS

##### 02.01 Management and Administrative Practices for Nuclear Criticality Safety

###### a. Objectives

1. Confirm\* that management has established and implemented an NCS policy.
2. Confirm that management, supervisors, and operators are responsible for and trained in NCS.
3. Confirm that a means for monitoring the NCS program has been established and implemented.

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\* See Section 03.00 (e) and (f) for special definitions and expectations of the terms "verify" and "confirm" used in this procedure.

4. Confirm that an NCS technical function independent of operations has been established and is functioning.

b. Requirements

1. Plant Policy for Nuclear Criticality Safety. Every year, confirm by discussions with plant management that written plant policy describing each employee's authority and responsibility for NCS remains unchanged. If changed, confirm that the changes do not adversely affect NCS by reducing organizational and/or personal responsibility.
2. Plant Manager's Responsibility for Nuclear Criticality Safety. During each inspection, confirm by observation and discussion with various employees that the plant manager has empowered every employee with the authority, responsibility, and training to ensure nuclear criticality safety. Confirm that the plant manager continues to show interest in NCS and that the plant manager holds his or her staff accountable for NCS.
3. Operations Managers' Responsibilities for Nuclear Criticality Safety. During each inspection, ask selected operations managers how the managers carry out their responsibility for nuclear criticality safety. Confirm by discussion and document review that authorities and responsibilities have been conveyed to individuals in each manager's organization. Based on the manager's knowledge of, and actions taken to monitor the nuclear safety program, confirm management's involvement in ensuring the effectiveness of the NCS program to avoid undue risk of nuclear criticality.
4. Operations Supervisors' Responsibilities for Nuclear Criticality Safety. During each inspection, conduct discussions with selected operations supervisors to decide the adequacy of their understanding of their responsibility for nuclear criticality safety. Confirm selected supervisors' understanding of NCS requirements about operations under his or her control. Confirm that these supervisors participate in the development and maintenance of procedures and provide training and require that personnel have an understanding of the procedures and the safety considerations, and that these supervisors confirm compliance with the procedures for new or modified process equipment, and require conformance with good safety practices, such as labeling of special nuclear materials (SNM) and housekeeping.
5. Nuclear Criticality Safety Function's Responsibilities. Every year, confirm by discussions with plant, operations, and NCS management and by review of organizational documents that: the NCSF reports to senior plant management independent of operations management; the NCSF maintains familiarity with all plant activities; the NCSF participates in inspections and audits; and the NCSF provides input to training.
6. Support Function Management Responsibilities for Nuclear Criticality Safety. During each inspection, confirm that

authorities and responsibilities have been conveyed to individuals in two selected support manager's organizations. Based on these managers' knowledge of, and actions taken to monitor the nuclear safety program, confirm management's involvement in ensuring the effectiveness of the program to avoid undue risk to NCS.

7. Management Involvement in Providing Written Administrative and Operating Procedures. Each year, confirm that administrative procedures exist to ensure that NCSF is consulted whenever a change or new activity affects NCS. Confirm that revised operating procedures are approved by NCSF whenever process changes are made.
8. Nuclear Criticality Safety Training. Each year, confirm that management has provided NCS training for all fissile material handlers, their supervisors and managers, support function engineers and managers, and the NCSF staff.
9. Nuclear Criticality Safety Advisory Committee. During each inspection, confirm that the safety advisory committee has met in accord with its management charter. For recommendations made since the last inspection, confirm that management has accepted or rejected the advisory recommendations and that, for the accepted recommendations, implementing actions and schedules have been assigned to specific plant organizations. For rejected recommendations, the basis for rejection should be documented.

## 02.02 Nuclear Criticality Safety Function

### a. Objectives

1. Confirm that procedures are being implemented that require the NCSF staff to evaluate each proposed process change and other program changes, and to establish NCS limits and controls for normal and accident conditions.
2. Confirm that selected NCS evaluations had been completed using validated methods.
3. Confirm that new NCS evaluations for modifications or newly installed equipment have been reviewed and validated as required by the license or certificate.

### b. Requirements

1. Administrative Procedures. Each year, confirm by observation, document review, and discussion that the NCSF maintains and implements administrative procedures for the establishment of limits and controls for SNM processing activities and renders advice to management for all NCS matters, including NCS inspections, audits, and training content.

2. Qualification of Staff. During each inspection, for select safety evaluations identified for review in 02.02(b)(4)\*\* confirm by document review that the NCS staff who did the NCS evaluations to establish NCS limits on controlled parameters and NCS control systems and reviewed the written operating procedures were deemed qualified by NCS management to do their respective functions.
3. Validation of Methods. During each inspection, for evaluations selected in 02.02(b)(4), confirm that the analytical method(s) had been validated prior to the safety evaluations (only ensure validation occurred).
4. Review of Nuclear Criticality Safety Evaluations/Identification of Contingencies. During each inspection, in preparation for the plant area tour (See 02.03), select one or more specific process areas for detailed, in-depth inspection. Confirm by document review that safety analyses for all process area operations within the selected area(s) include identified contingencies and controls that could lead to nuclear criticality.
5. Provision for Double Contingency. During each inspection, confirm by document review and discussion, for the safety analyses identified for review in 02.02(b)(4), that NCS control systems are provided to ensure that at least two unlikely, independent, and concurrent changes in process conditions must occur before a criticality is possible.
6. Independent Reviews of Nuclear Criticality Safety Evaluations. During each inspection, for the safety evaluations identified for review in 02.02(b)(4), confirm by discussion and document review that independent reviews were documented. Confirm that the reviews were done independently, and that the reviewed material is identified in the documentation.
7. Safety Criteria. During each inspection, for the safety evaluations identified for review in 02.02(b)(4), confirm by discussion and document review that the evaluations specify NCS limits for controlled parameters and NCS control systems.

## 02.03 Plant Activities

### a. Objectives

1. Confirm that process and process related activities are done by following written procedures containing NCS limits on controlled parameters and required use of NCS control systems.

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\*\* See 03.00(c)

2. Confirm the adequacy of the regulatee's NCS program by taking a vertical slice look at a selected plant process area, reviewing the NCS evaluations as required by 02.02(b)(4) to identify NCS limits and controls for the selected area, and then confirming that the NCS limits and controls are implemented and maintained by all the management functions of organizations, use of procedures, postings, training, inspection, audits, configuration control, maintenance, etc.

b. Requirements

1. General Plant Tour. During each inspection, tour each major plant operating area (e. g., yards and warehouses, laboratories, chemical production, ceramic production, assembly, shipping, scrap processing, and waste handling) to monitor plant operations on all shifts and to monitor non-routine operations. Confirm that:
  - a. by observations, document review, and discussions, managers, supervisors, and operators are performing duties as described in written procedures, and that SNM labeling and area postings identify SNM limits on controlled parameters.
  - b. fixed neutron poisons are present in the configuration specified in the operating procedure.
  - c. access to SNM areas is controlled.
  - d. generic lessons learned from events at other SNM facilities have been implemented in all plant areas.
  - e. operators are following operating procedures.
  - f. inventory records (logs and container labels) are consistent with posted limits.
  - g. containers, transfer carts, and storage racks are labeled and do not exceed posted limits.
  - h. operators are controlling the inadvertent buildup of SNM in glove boxes and other confinement equipment.

Observe:

- a. that other radiation safety devices (e.g., filter bank pressure gages, flow meters, etc.) are operative and within specified safe range.
- b. the condition of air sampling equipment, personnel monitoring equipment, protective clothing, respiratory equipment, window stops on fume hoods, and ventilation equipment for air flow.
- c. housekeeping for stored combustibles such as solvents and paints and refuse areas containing

rag, paper, or other combustibles in production areas within the Prefire Plan where water is not permitted for firefighting.

- d. storage of toxic materials for proper storage.
- e. emergency egress routes that may be blocked by storage of materials.

- 2. Implementation of Established Safety Analyses/Observe Operations. During each inspection, for the safety analyses identified for review in 02.02(b)(4), confirm by extended observations, discussions, and document review that management functions (establishment of written procedures, training, inspections, maintenance, etc.) and plant activities are being conducted as described in, or in support of, the requirements in the safety analyses and the license or certificate. This confirmation effort includes the physical presence of safety control systems as described in the safety analyses; the as-built inspection documentation by the regulatee; control of the process environment; establishment of procedures for operations, maintenance and surveillance; postings and SNM container labeling; training of staff; and provisions for inspections and audits.
- 3. Identified Issues. During each inspection, for issues identified by the Headquarters Staff, pursue resolution of the issue as requested.

02.04 Configuration Control Program for Nuclear Criticality Safety

a. Objectives

- 1. Confirm that documents defining system configuration, operation, and maintenance are maintained and accessible.
- 2. Confirm that NCS evaluations are included in the configuration control system.
- 3. Confirm that NCSF staff provides guidance for process design, operating procedure development, and operator training.

b. Requirements

- 1. Program. Confirm that supervisors review active operating procedures at least every two years. Confirm that the movement of SNM is controlled by procedure.
- 2. Nuclear Criticality Safety Evaluations. [Headquarters Staff responsibility]
- 3. Maintenance, Calibration, and Surveillance of Safety Systems. During each inspection, for each fissile unit operation selected for review in 02.02(b)(4), confirm by observation, discussion, and document review that the

maintenance program includes the schedules for preventive maintenance, calibration, and periodic surveillance as required by the reliability analysis section of the safety evaluation. Confirm that replacement parts for safety controls systems are controlled and have been approved for use in the safety analyses.

4. Procedures. During each inspection, for each safety evaluation reviewed in 02.02(b)(4), confirm by observation, discussion, and document review that the operating procedures contain the NCS limits for controlled parameters, prescribe the presence of all NCS control systems, and identify the requirements for reliable operation of active safety control systems. Confirm that, as appropriate, maintenance, calibration, and surveillance procedures are in place. Confirm that NCS training, inspection, and audit requirements have been documented and are in effect.
5. Configuration Control Change Procedure. During each inspection, confirm that the procedure has not been changed since the last inspection. If changed, confirm that the procedure change does not adversely affect NCS.
6. Configuration Control Training. Each year, confirm by discussion, observation, and document review that performance-based training for the configuration control program has been provided to all employees. Confirm by discussion with selected managers, supervisors, and operators that the training has been effective.

#### 02.05 Nuclear Criticality Safety Change Control

##### a. Objectives

1. Confirm that change control procedures are implemented.
2. Confirm that changes potentially affecting NCS are identified, reviewed, and evaluated.

##### b. Requirements

1. Documentation. [Headquarters Staff responsibility].
2. Confirmation. During each inspection, for changes noted during the plant tour, confirm that NCS analyses have been established for the changed process. Confirm that operations are reviewed at least annually to ensure that procedures are followed and that process conditions affecting NCS are not changed.

#### 02.06 Operating Procedures

##### a. Objectives



1. Confirm that written procedures, including NCS considerations, exist and are accessible to operators.
2. Confirm that operating procedures are up-to-date and that operators are trained in their use.

b. Requirements

1. Nuclear Criticality Safety Limits and Controls. During each inspection, confirm by observation, discussion, and document review that limits for controlled parameters and NCS controls (or control systems) identified in the NCS analyses selected in 02.02(b)(4) are contained in written operating procedures.
2. Nuclear Criticality Safety Participation in Establishment of Procedures. During each inspection, confirm by observation, discussion, and document review that operating procedures reviewed by the inspector during the inspection have been reviewed by NCS to ensure that limits for controlled parameters and NCS control requirements have been correctly transcribed. Confirm that operations personnel participated in the development of operating procedures.
3. Document Control of Operating Procedures. Each year, confirm by observation, discussion, and document review that a document control system is being implemented to withdraw old procedures and to install current procedures.
4. Operators Trained in Operating Procedures. Each year, confirm by observation, discussion, and direct observation that operators and supervisors are trained in new procedures before they are put into use. Confirm that records of training are maintained.
5. Deviation from Procedures. During each inspection, confirm that deviations from procedures and unforeseen process changes affecting NCS are reported to management, are documented, and are investigated promptly. Confirm that corrective actions are scheduled and completed.

02.07 Maintenance for Nuclear Criticality Safety Control Systems

a. Objectives

1. Confirm that procedures for regularly scheduled and nonroutine maintenance for NCS control systems exist and are implemented.
2. Confirm that maintenance changes are reviewed for NCS before a restart of operations.

b. REQUIREMENTS

1. Scheduled Maintenance and Calibration. During each inspection, confirm by document review, observation, and discussion, for the safety analyses identified in 02.02(b)(4), that requirements for maintenance and calibration of NCS control systems have been established per written procedures as required by the NCS evaluation. Confirm that replacement parts are specified in the procedure or that the NCSF has approved the new parts before installation. Every year, confirm that the configuration control program is used to control replacement parts.
2. Written Procedures for Maintenance and Calibration. During each inspection, confirm by document review, observation, and discussion, for the safety analyses identified in 02.02(b)(4), that written procedures are available and were followed for the performance of the maintenance and calibration work on NCS control systems. Records of the work should be on file.
3. Training of Maintenance Personnel. During each inspection, confirm by document review and discussion, for the safety analyses identified in 02.02(b)(4), that personnel doing maintenance or calibration on NCS control systems are trained in the procedures before use of the procedures.
4. Functional Testing Following Maintenance. Each year, confirm that functional testing is done after maintenance on NCS engineered control systems.

02.08 Nuclear Criticality Safety Training

a. Objectives

1. Confirm that managers, supervisors, and staff are trained in NCS.
2. Confirm that all staff with access to fissionable material areas have appropriate initial and periodic documented training.

b. Requirements

1. New Staff. Each year, confirm by discussion, document review, and direct observation that all staff having access to SNM areas receive training on the NCS program, the emergency program, and each individual's authority and responsibility for NCS. Confirm that each SNM handler receives on-the-job training and is tested to confirm that the SNM handler has the required skill to conform to the written NCS procedures for his operation before the operator works without continuous surveillance.
2. Retraining by Position - Managers, Supervisors, Operators. Each year, confirm by discussion, document

review, and observation that each individual receives performance-based training (knowledge and skills) to understand his organizational authority and responsibility for nuclear criticality safety.

3. Training Curricula. Each year, confirm by observation that the curriculum discusses the NCS control parameters used to prevent plant criticality. Confirm that the required response to the criticality alarm signal and to plant policy and procedures is discussed.
4. Testing and Records. Each year, confirm by observation and document review that testing is done to confirm the adequacy of the training and that records of the training and tests are maintained.

02.09 Nuclear Criticality Safety Inspections, Audits, and Investigations

a. Objectives

1. Confirm that NCS staff inspects process operations and audit performance for NCS.
2. Confirm that procedural violations, equipment, or system failures related to NCS are reported, reviewed, and that resolutions are tracked.

b. Requirements

1. Inspection Program. Each year, confirm by observation, discussion, and document review that the regulatee requires every individual to report all detected violations of NCS requirements to area supervision. Confirm that area management representatives and NCS staff routinely inspect all areas.
2. Audit Program. Each year, confirm that the audit report is forwarded to plant management and to appropriate plant staff. Confirm that plant management accepts or rejects each audit recommendation and that responsibility for corrective action is assigned.
3. Investigation Program. [Headquarters Staff responsibility]
4. Corrective Actions. During each inspection, confirm by observation, discussion, and document review that the NCSF reviews proposed corrective actions and that all corrective actions are completed on schedule. Confirm that the regulatee confirms the adequacy of the corrective actions.

## 02.10 Criticality Alarm Monitoring Systems

### a. Objectives

1. Confirm that a monitoring/alarm system is provided for all fissionable material areas.
2. Confirm that the system is tested to confirm reliability and operability.

### b. Requirements

1. System Design. For changes to system only, during each inspection, confirm by observation, discussion, and document review that all system design features retain dual detector coverage for all SNM areas, that electronic logic requires that two detectors be in the alarm mode before sounding the alarm, that audio alarms and, as necessary due to noise levels, other alarms are available and operational in all areas that could be affected by a criticality, that system surveillance is provided to warn of detector failure, and that secondary emergency power is provided.
2. System Sensitivity. Each year, confirm that access to the alarm set points is controlled to prevent inadvertent modification of the set points.
3. System Testing. Each year, confirm by observation, discussion, and document review that the system is designed to permit component and system operability testing periodically and after maintenance. Confirm that maintenance and testing of the entire alarm system are done and that such tests are announced.

## 02.11 Nuclear Criticality Safety Emergency Response

### a. Objectives

1. Confirm that procedures are provided for response to criticality events.
2. Confirm that staff is trained in procedures and that periodic drills are performed.
3. Confirm that NCS precautions for firefighting are in place and reasonable.

### b. Requirements

1. Emergency Plan. [Headquarters Staff responsibility]
2. Emergency Procedures. Each year, confirm that emergency procedures have not been changed substantively. Confirm that NCS precautions for firefighting are included in the emergency procedures. Confirm that the on- and off-site emergency response personnel, including fire response

personnel, are provided with guidance and adequately trained on fighting fires in fuel handling areas. Confirm that for areas in which firefighting restrictions exist because of criticality safety concerns, appropriate postings are in place that clearly and concisely portray such restrictions.

3. Controlled Evacuation of Personnel. Each year, confirm by document review, observation, and discussion with multiple employees and contractor staff that evacuation procedures are established and have been made known to all employees and contractor staff in areas that could be affected by radiation from a nuclear criticality. Confirm that all tests and drills are announced before the drills and/or tests. If any shutdown procedure is necessary, confirm that the procedure is in place and can be done promptly as the person leaves the area.
4. Accounting of Personnel. Each year, confirm by observation, discussion, and document review that accounting of personnel is to be accomplished promptly after evacuation so that personnel rescue efforts and medical treatment can be considered if necessary.
5. Controlled Reentry. Each year, confirm by observation, discussion, and document review that reentry is controlled by written procedures and that equipment such as radios and radiation detection devices are available for the reentry team. Confirm that the criticality alarms can and will be silenced at an external plant area before reentry and that a control center is available for personnel accounting and for reentry.
6. Testing of Monitor Alarm System. Each year, confirm by observation, discussion, and document review that the monitor alarm system is tested periodically by electronic signal and by radiation sources. Confirm that at regular intervals, the system is tested as a unit, i.e., detectors, logic control system, and alarms. Confirm that the system is tested for operability immediately after maintenance is done.
7. Drills. Each year, confirm by observation, discussion, and document review that all employees and contractor staff are involved in announced periodic drills (at least annually) to evacuate the area to designated assembly areas. Confirm that designated reentry teams participate in periodic training reentry drills. Confirm that the alarm is sounded periodically for employee familiarization with the alarms and to confirm that the alarms can be heard in all locations.

88020-03 INSPECTION GUIDANCE

03.00 Background

- a. Possession, use, and handling of special nuclear material (SNM) at fuel cycle facilities are regulated under 10 CFR Part 70. Specific discussion of regulatee requirements related to inspection are provided in 10 CFR 70.55, including a requirement for NRC staff to have immediate, unfettered access to the facility always and access to records upon reasonable notice. The provisions of 10 CFR 70.24 require installation and use of a criticality event monitoring system. Other requirements for NCS are found in the SNM license or certificate.

The ANSI/ANS-8 standards help to define a minimally acceptable NCS program. NRC regulatory guides have endorsed these standards in a limited way. The inspectors should be familiar with the standards and guides and with the contributing causes for, and lessons learned from, nuclear criticality accidents. The inspection program utilizes guidance in the standards and the lessons learned to focus the inspection effort. If the inspector cannot confirm program elements in this inspection program, the regulatee has a program deficiency.

- b. The inspection procedures are organized according to the elements required for a regulatee's NCS program. The elements address the following functions: management and administration; NCS evaluations; change control; operating and maintenance procedures; training, inspections, audits, and investigations; criticality alarms; and emergency response.
- c. Efficient use of NRC staff and regulatee resources is based on division of responsibilities between NRC headquarters and region staff. Verification of the regulatees' programmatic aspects of the NCS program for new or changed processes is the responsibility of the headquarters staff. In particular, review of the adequacy of a regulatee's new NCS evaluations and the adequacy of identified NCS limits for controlled parameters and control systems in these new evaluations is the responsibility of the headquarters staff. Confirmation of management functions to maintain implementation of NCS limits and controls for existing processes is the region staff's responsibility. NCS reviews conducted in the license or certificate renewal process establish a safety baseline and subsequent region staff inspections are focused on maintaining the NCS program approved by the last renewal. Headquarters staff reviews are anticipated on a biannual basis while region inspections are expected to be on a quarterly interval.
- d. The major portion of the inspector's time for any routine inspection will be spent confirming the adequacy of the regulatee's NCS program by taking a vertical slice look at the program in one plant area. This will be accomplished by selecting a plant process area, reviewing the NCS evaluations as required by 02.02(b)(4) to identify NCS limits and controls for the selected area, and then confirming that the NCS limits and controls are implemented and maintained by all

the management functions of organizations, use of procedures, training, inspection, audits, configuration control, etc. The plant areas selected for the vertical slice should be rotated during subsequent inspections.

- e. Verify, as used in the headquarters inspection procedure, is the process by which the technical and administrative components of the regulatee's NCS program are examined to confirm that the NCS program is adequate to control the risk of criticality. The process includes examination of the new NCS evaluations, including the basic assumptions and the proper application of the calculational methods, to confirm that the NCS limits for controlled parameters and NCS control systems are an adequate technical basis. The process also includes examination of the adequacy of the management practices to implement the NCS limits for controlled parameters and control systems for the new or changed processes, which constitute the administrative component of the NCS program. Finally, the process includes assessment of attitude of the operations staff that should have a sense of ownership for the NCS program and should demonstrate vigilance for the rigor of the NCS program. Verification occurs when all three components are examined and found adequate to assure NCS.
- f. Confirm, as used in this procedure, is the process by which the administrative components of the regulatee's NCS program are examined to determine that the NCS program is adequate to control the risk of criticality for processes that are not subject to recent change (and not inspected by HQ). The process includes examination of the established NCS evaluations to identify the NCS limits for controlled parameters and NCS control systems. The process also includes examination of the adequacy of the management practices to implement the NCS limits and control systems that constitute the administrative component of the NCS program. Finally, the process includes assessment of attitude of the operations staff that should have a sense of ownership for the NCS program and should demonstrate vigilance for the rigor of the NCS program. Confirmation occurs when all three components are examined and found adequate to assure NCS.
- g. The following definitions apply to terms used in this procedure.

safe geometry system - a system whose dimensions and shape are such that a nuclear criticality event can not occur for any combination of values of system parameters including not limited to moderation; reflection, or nuclide mass, concentration, or enrichment.

favorable geometry system - a system whose dimensions and shape are such that a nuclear criticality event can not occur for any combination of values of system parameters if the values of a subset of the parameters are maintained within specified limits.

contingency - a change or failure of process equipment, measurement, or control systems; inadvertent human action; change in ambient conditions; or natural events which are considered unlikely.

accident pathway - a unique set of events, sequential or parallel in nature, which could lead to a nuclear criticality event.

- h. Several subsections of the inspection requirements have headings without any requirements. This is to let inspectors know that a necessary portion of the regulatee's NCS program is to be inspected by the headquarters staff.
- i. The detailed guidance presented below addresses the program elements introduced above.

03.01      Management and Administrative Practices for Nuclear Criticality Safety

a.      Plant Policy for Nuclear Criticality Safety

Plant policy should express the importance of plant safety, including nuclear criticality safety, in relation to production activities, i.e., the safety basis should be as important as production. The policy should empower each employee to question the adequacy of safety requirements and should prohibit operations when safety questions cannot be immediately resolved. Furthermore, each individual, regardless of position, is ultimately responsible for NCS in his or her own work area. If any changes are made to the plant policy, the inspector should confirm that the changes do not diminish personal or organizational responsibility for NCS.

b.      Plant Manager's Responsibility for Nuclear Criticality Safety

The plant manager is expected to demonstrate overall responsibility for an NCS program for operations by showing continued interest in the program. The responsibility for establishing practices carrying out the NCS requirements should be delegated through instructions and procedures. The plant manager is also expected to monitor the NCS program by operational reviews and for periodic independent reviews of the NCS organization.

c.      Operations Managers' Responsibilities for Nuclear Criticality Safety

Operations managers are expected to implement (take ownership of) NCS responsibilities by ensuring that appropriate training is provided to staff under their supervision, and by monitoring the activities under their control that affect nuclear criticality safety. Other actions should include assuring availability of NCS limits in written procedures for all operations, controlling facility and process changes via



the configuration control method, and making direct observations of on-the-floor NCS conditions.

d. Operations Supervisors' Responsibilities for Nuclear Criticality Safety

Each supervisor is expected to be knowledgeable about NCS for operations under his control, and to provide adequate NCS training for personnel under his supervision such that they would be expected to follow procedures. Further, the supervisor is expected to maintain records of training activities, to ensure compliance with operating procedures containing NCS limits and control systems, and to require conformance with good safety practices including unambiguous identification of fissile materials and good housekeeping.

e. Nuclear Criticality Safety Function's Responsibilities

The Nuclear Criticality Safety Function is expected to: review changes to operating procedures; maintain familiarity with all operations within the facility requiring NCS controls; conduct or participate in inspections and audits of criticality safety practices; examine reports of procedural violations and other deficiencies for possible improvement of safety practices; and report their findings to plant management. These activities should be influenced by priorities established by operations, but should not be controlled by operations.

f. Support Function Management Responsibilities for Nuclear Criticality Safety

Support function managers should carry out their responsibility for NCS in a manner similar to operations management. The authorities and responsibilities should be conveyed to individuals in each manager's organization in written documents and in training programs.

g. Management Involvement in Providing Written Administrative and Operating Procedures

Requirements should be established for developing, approving, and updating administrative and operating procedures for activities involving NCS. Biennial review of procedures for operations should be performed.

h. Nuclear Criticality Safety Training

Management is to provide training on NCS limits and control systems, as well as requiring that personnel have an understanding of procedures they would be expected to follow. Records of training activities and verification of personnel understanding must be maintained at least for the duration of the license or certificate.

i. Nuclear Criticality Safety Advisory Committee

An advisory group should assess the adequacy and effectiveness of the NCS program for the plant manager. The assessment should include a systematic examination and should be distinct from routine audits. The assessment should be conducted by a team with multi-disciplined personnel possessing the expertise necessary for proper review of the programs.

### 03.02 Nuclear Criticality Safety Function

#### a. Administrative Procedures

Specific authorities, responsibilities, and duties should be defined in written administrative procedures approved by the NCSF manager. Procedures should be used for NCS evaluations, inspections, audits, and procedure review.

#### b. Qualification of Staff

The NCS staff that performed NCS functions reviewed during this inspection should have documented qualifications that met regulatee requirements at the time that the function was performed.

#### c. Validation of Methods

The regulatee should have reference to a validation report for every computational method used in all NCS evaluations. The inspector should confirm the existence of such reports for evaluations reviewed per 02.02(b)(4).

#### d. Review of Nuclear Criticality Safety Evaluations/Identification of Contingencies

For the NCS evaluations reviewed per 02.02(b)(4), each NCS evaluation is expected to have a criticality analysis for all normal and abnormal conditions. NCS limits for controlled parameters and control systems for each condition should be identified. In this context, storage and packaging of SNM are considered to be steps in the process. Descriptions of process equipment configurations should be in operating procedures. The inspector should identify all NCS limits and controls and, during the course of the inspection, confirm that all limits and controls are in operating procedures which are being followed.

Note: Older NCS evaluations may not meet current standards. If the basic information, (i.e., controlled parameters, NCS limits, and NCS control systems) is not available, the regulatee should have a schedule to reconstitute the safety basis. This should be called to HQ's attention.

#### e. Provision for Double Contingency

The accident scenarios identified in the NCS evaluation should require that two or more unlikely, concurrent, and independent changes in process conditions are required before

a criticality could occur (double contingency). No single failure will result in a criticality accident. Passive, active engineered, or administrative controls applied to ensure conformance to the double contingency principle should be identified. Passive controls are favored over active controls and use of administrative controls should be justified in writing. For the evaluations identified in 02.02(b)(4), the inspector should be able to identify at least two controls for each pathway. In the course of the inspection, the inspector should confirm that the limits and controls are in operating procedures that are followed.

f. Independent Reviews of Nuclear Criticality Safety Evaluations

Independent review of each criticality evaluation is required before approval of the proposed process change. The reviewer and the review considerations should be documented as part of the evaluation. The documentation for the safety evaluation should show that the NCS limits on controlled parameters and the requirements for NCS control systems have been discussed with operations management and that operations management accepts the limits and controls. For the safety evaluations reviewed per 02.02(b)(4), the inspector should confirm that the license or certificate performed these actions as part of the process of approving the existing process.

g. Safety Criteria

NCS evaluations are expected to provide assurance that the entire process is subcritical under both normal and abnormal operating conditions prior to start-up of the process. The evaluation should demonstrate that margins of safety satisfy plant requirements which were established by the NCSF and were approved by the plant manager. The inspector should confirm, for the evaluation reviewed in 02.02(b)(4), that safety margins were applied as required by plant documents on NCS.

03.03 Plant Activities

a. General Plant Tour

The purpose of the general tour is to confirm that plant operations are in accord with configuration control requirements during all phases of operation. Because of the nature of accidents, unusual operations should be observed with great diligence. The operations staff's knowledge of normal conditions, conformance with the operating procedure, and response to maloperation should be confirmed during this phase. Discussions with the operating crews can be used to confirm that training has been conducted and is effective. The inspector must be constantly recalling contributing causes and lessons learned from criticality accidents during this phase of the inspection. The inspector's judgment that operations are conducted safely is key to an adequate inspection program.

b. Implementation of Established Safety Analyses/Observe Operations

Review of the safety analyses selected in 02.02(b)(4) should have identified management functions, equipment conditions, NCS limits on controlled parameters and NCS controls, and support staff activities which contribute to safe operation. In-the-field verification of the requirements of these safety analyses is the focus of this inspection procedure.

Examination of equipment and facilities should confirm that limits and controls identified in the safety evaluation are in existence and are being used. Operating procedures should be reviewed to confirm that NCS limits on controlled parameters and NCS control systems are contained in the procedures. Observation of, and discussions with operators should confirm that operators know and understand process conditions, NCS limits on controlled parameters and NCS controls, and have the skill to follow the procedures. Review and observation of maintenance, calibration, and surveillance activities should confirm that these activities are performed on schedule and meet functional requirements. Discussions with area operations management and the NCS staff should confirm that corrective actions have been taken in response to inspection and audit findings. The inspection should confirm that unreviewed changes in process conditions, NCS limits and controls, and procedures have not occurred.

Most important, using lessons learned from past accidents, confirm that the selected area is safe.

03.04 Configuration Control Program for Nuclear Criticality Safety

a. Program

The inspector should confirm that documents reviewed during the inspection, especially those reviewed in conjunction with the inspection requirements associated with the NCS evaluations identified in 02.02(b)(4), are controlled by the program.

b. Nuclear Criticality Safety Evaluations [Headquarters Staff responsibility]

c. Maintenance, Calibration, and Surveillance of Nuclear Criticality Safety Control Systems

The inspector should confirm that maintenance and calibration schedules are available for the NCS control systems, especially those reviewed in conjunction with the inspection requirements associated with the NCS evaluations identified in 02.02(b)(4), and are controlled by the program.

d. Procedures

For the inspection requirements associated with the NCS evaluations identified in 02.02(b)(4), operating procedure should be based on information maintained in the configuration control system and should be maintained in the system. The procedures should contain step-by-step actions, identify NCS limits and controls, necessary conditions for start-up and operation, and special warnings about hazardous situations. Maintenance and calibration procedures should provide detailed maintenance and surveillance requirements, including lockout requirements and post maintenance checks to return the controls to service. Provisions for record keeping should be within the procedure.

e. Configuration Control Change Procedure

The change procedure is intended to guide the regulatee's staff in initiation of all change processes; development, revision, and maintenance of documents; and the identification of management functions (retraining, maintenance, audits, etc.) required to be performed as part of the change process. Only changes need to be reviewed.

f. Configuration Control Training

Facility staff should be trained to use the configuration control system to enhance safety, to implement change, and to be responsible for conformance to the configuration control system. This ranges from complying with operating procedures to the more complex change control process.

03.05 Nuclear Criticality Safety Change Control

a. Documentation [Headquarters Staff responsibility]

b. Confirmation

This inspection procedure confirms for changes since the last headquarters and region inspection that the change control procedure has been followed and documented. It is expected that the tracking record is complete and that analyses and documents prepared in the change process are complete and available within the configuration control system.

03.06 Operating Procedures

When NCS is pertinent, operations are expected to be governed by written procedures. All persons participating in these operations should understand and be familiar with the procedures. The procedures should specify all parameters they are intended to control. The procedures should be organized and presented for convenient use by operators and should be free of extraneous material.

The contents should include process operating limits, sequence of steps to be taken under upset conditions, safety systems and functions, precautions, and warnings. The procedures should address all aspects of operation including startup, temporary

operation, and shutdown. Instructions and criteria for shutdown and actions to be taken during abnormal operations should be specified, including the limits selected for a commitment to action. Requirements should be documented for measurement control. Measurement techniques employed should be identified and the technical basis for their validity provided. If moderation control is used, requirements should be documented for moderation control within an Emergency Plan and a Prefire Plan.

a. Nuclear Criticality Safety Limits and Controls

Approved written operating procedures, postings, and labeling of containers are expected to effectively enhance implementation of the NCS limits on controlled parameters and control systems specified in the NCS evaluations. For the activities reviewed in coordination with the evaluations in 02.02(b)(4), the written procedures should clearly specify and uniquely highlight the parameters, limits, and actions necessary to provide criticality safety as specified in the NCS evaluation.

b. Nuclear Criticality Safety Participation in Establishment of Procedures

For procedures developed to implement the NCS limits and controls identified in NCS evaluations in 02.02(b)(4), operations supervisors and operators should participate in this process in order to ensure that the steps important to criticality safety can be effectively implemented. All new and revised procedures that impact NCS are expected to be reviewed by the NCS staff.

c. Document Control of Operating Procedures

A program should be in place to specify the methods and practices for development, revision, review, approval, and implementation of written procedures for plant operations, maintenance, and surveillance. The program should include the periodic reviews to ensure continued applicability and adequacy of procedures and the responsibilities for updating procedures. Procedures reviewed in conjunction with the safety evaluations in 02.02(b)(4), should be confirmed to be in the document control system and that the document control system is working. Adequacy of the program is a Headquarters review function.

d. Operators Trained in Operating Procedures

In conjunction with the safety evaluations identified for review in 02.02(b)(4), the inspector should confirm that operators are adequately trained on all criticality-safety-related procedures. Supervisors are expected to provide training and require that personnel under their supervision have an understanding of the expected procedures and safety considerations so as perform their functions without undue risk. Records of training activities and verification of operators' skills are expected to be maintained.

e. Deviations From Procedures

The regulatee should require that deviations from operating procedures and unforeseen alterations in process conditions that affect NCS be documented, reported to management, and investigated promptly. Action should be taken to prevent a recurrence. These requirements should be documented. The inspector should confirm implementation of this procedure.

03.07 Maintenance for Nuclear Criticality Safety Control Systems

a. Scheduled Maintenance and Calibration

The plant is expected to have a maintenance and calibration program for all of the NCS control systems that are identified in the criticality safety evaluations. These systems could be instrumentation, such as temperature and level monitors, or physical systems such as barriers, constraints, neutron absorbers, etc. For these systems, NCS depends on continued maintenance and/or surveillance of the systems and calibration of the instrumentation. The safety analyses should identify the maintenance and calibration requirements for these systems. A system should include a scheduling and tracking system so that operations and management personnel will know what maintenance and calibration activities are planned and track those that have been performed. Records should be available that identify when maintenance and calibration actions were performed on the criticality safety systems. These records would be expected to identify the personnel performing the activities.

Since NCS depends on these safety systems, all changes to the systems must be carefully considered to avoid unanticipated consequences. This includes simple replacement of parts or "improvements." In some cases, specific materials or geometries involved in the system are important to NCS but these features may not be obvious to maintenance personnel. Problems have arisen in the past with use of unauthorized replacement parts that served the purpose, but reduced the criticality safety margin afforded by the original design. Allowable replacement parts should be documented in procedures (preferably the maintenance procedure for the safety system). All other changes to the safety system, including use of non-authorized replacement parts, should be approved by the NCS manager prior to installation. A configuration control system should be in place to control these replacement parts.

b. Written Procedures for Maintenance and Calibration

Written procedures should be available for performing all maintenance, calibration, and surveillance requirements for the NCS control systems identified in the criticality safety evaluations. There should be records to confirm that the work was performed.

c. Training of Maintenance Personnel

A training program should be in place for the personnel performing maintenance or calibration procedures on NCS control systems identified in the criticality safety analyses. This program should provide reasonable assurance that the procedures can be performed as specified. The program should also identify if and when refresher training is required and provide for maintenance of records of the original and refresher training. Training records should be readily available to the managers making maintenance and calibration assignments.

### 03.08 Nuclear Criticality Safety Training

#### a. New Staff

A training program should be in place that ensures that all staff having unescorted access to SNM areas receive training in the NCS program, the emergency program, and in each individual's authority and responsibility for NCS. In addition, the training program should ensure that each SNM handler receives on-the-job training and is tested to confirm that the SNM handler has the required skill to conform to the written procedures for his/her operation. Written records of this training should be readily available to and used by operations, maintenance, and support function managers making work assignments in SNM areas. The NCS staff should assist in the development and approval of the training program, and to assist in training if requested.

#### b. Retraining by Position - Managers, Supervisors, Operators

The training program should also ensure that each individual within the organization, including managers, technical, supervisors, and operators, receives performance-based training (knowledge and skills) to understand his organizational authority and responsibility for nuclear criticality safety. Each individual at the plant is expected to understand his or her role and responsibility for criticality safety.

#### c. Training Curricula

The criticality safety training curriculum for all staff having access to SNM areas is expected to contain:

- A description of NCS control parameters used in the NCS program.
- A discussion of the required response to the criticality alarm signal, to plant policy, and to emergency response procedures.

The NCS training program is expected to be performance-based, with the degree of training proportional to the position of responsibility.

#### d. Testing and Records



The nuclear criticality safety training program is expected to require testing to confirm the adequacy of the training and level of knowledge of the staff having unescorted access to the SNM areas. Records, including the grades and testing dates, are expected to be maintained for all personnel. The training status of personnel should be readily available and used to authorize unescorted access to the SNM areas.

03.09 Nuclear Criticality Safety Inspections, Audits, and Investigations

a. Inspection Program

The regulatee is expected to have an inspection and reporting program that ensures that nonconformance with criticality safety requirements is promptly identified and corrected by area supervision. The program should require every individual to report all suspected nonconformance of written NCS requirements and procedures. This self reporting should be strongly encouraged and should be "penalty free" to those reporting to encourage personnel to report mistakes.

The self-inspection program is also expected to require that area management representatives and NCS staff routinely inspect all areas with SNM. Operations should be reviewed frequently (at least annually) to ascertain that procedures are being followed and that process conditions have not been altered so as to affect the NCS evaluation.

The self-inspection program is also expected to require that corrective actions be performed in a reasoned, controlled manner by written instructions reviewed by NCSF.

b. Audit Program

The regulatee is expected to have an audit program to assess the adequacy of the NCS program at least annually. This audit program should be a management responsibility. A formal report of the audit team should be forwarded to plant management as well as to appropriate plant staff. Corrective actions for violations of written requirements should be assigned to individuals and should be scheduled. Plant management is expected to accept or reject each audit recommendation, assign responsibility for corrective action, and schedule and monitor the progress of the corrective action. These reviews should be conducted, in consultation with operating personnel, by individuals who are knowledgeable in NCS and who, to the extent practicable, are not immediately responsible for the operation. These audits should include overall criticality safety practices and compliance with procedures.

c. Investigation Program. [Headquarters Staff responsibility]

d. Corrective Actions

Following discovery of a criticality nonconformance, corrective actions should be developed and implemented to reduce the probability of the problem reoccurring. The regulatee is expected to have a program that tracks and monitors the progress of the criticality safety-related corrective actions. This program should allow management to know the status and schedule of each corrective action. The corrective actions identified should be reviewed by management and the NCS staff to confirm the adequacy of the corrective action prior to its initiation. Prior to close out of the action, management and the NCS staff should confirm that the corrective action is adequate.

### 03.10 Criticality Alarm Monitoring Systems

#### a. System Design

System design will be reviewed during license or certificate renewal and verified by headquarters inspections. The region inspector should review the system to detect design changes only.

#### b. System Sensitivity

Written procedures are expected to specify alarm set points to be used to indicate when radiation levels exceed the regulatory limits. The procedures should also provide for control of access to the alarm set points to prevent inadvertent modification of the set points.

#### c. System Testing

The criticality accident alarm system is expected to be designed to permit component and system operability testing periodically and after maintenance. The regulatee is expected to have procedures in place to require tests and checks equivalent to the initial installation tests following significant modification or repair to the system.

All tests and corrective actions should be recorded. Maintenance, surveillance, and test records for the alarm system are expected to be maintained.

### 03.11 Nuclear Criticality Safety Emergency Response

#### a. Emergency Plan. [Headquarters Staff responsibility]

#### b. Emergency Procedures

The planned response by the regulatee staff to a nuclear criticality accident alarm should to be outlined in emergency response procedures approved by management.

Organizations, on- and off-site, that are expected to provide assistance during emergencies should be informed of conditions that might be encountered and should be assisted in preparing suitable emergency response procedures. The on-

and off-site emergency response personnel, including fire response personnel, should be provided with guidance and adequately trained on fighting fires in fuel handling areas. A Prefire Plan should be available for any facility or process in which the threat of fire exists and criticality due to the addition of moderator or disruption of material as a result of firefighting is a concern. The procedures should include criticality safety considerations and should be approved by the cognizant criticality safety organization. For areas in which firefighting restrictions exist because of criticality safety concerns, appropriate postings should be in place which clearly and concisely portray such restrictions.

c. Controlled Evacuation of Personnel

Emergency procedures should clearly designate evacuation routes. These routes should follow the quickest and most direct routes practicable. The routes should be clearly identified and should avoid recognized areas of higher risk. The routes should lead personnel to preestablished assembly areas or rally points for accounting.

These evacuation procedures should be made known to all employees in areas which could be affected by radiation from a nuclear criticality. The procedures should also make provision for the evacuation of transient personnel. The emergency procedures should provide instructions on what actions, such as emergency shutdowns, should be performed prior to evacuation.

d. Accounting of Personnel

The emergency procedures and systems should permit the prompt accounting of personnel after evacuation so that personnel rescue efforts can be considered if necessary.

e. Controlled Reentry

Reentry should be controlled by written procedures and equipment, such as radios and radiation detection devices and should be available for the reentry team. Field survey instrumentation used for reentry should be capable of providing adequate warning of the recurrence of a criticality excursion. In order to facilitate emergency response, provision should be made to silence the criticality alarms at an external plant area. Written procedures should require that the alarms be silenced before reentry.

The criticality safety program should require that reentry and recovery from a limit violation be governed by corrective procedures that ensure the remaining safety margin is acceptable, or not further reduced if already unacceptable. The criticality safety function should review all recovery procedures.

f. Testing of Monitor Alarm System

The monitor alarm system is expected to be tested periodically either by an electronic signal or by radiation sources. At regular intervals the entire system is expected to be tested as a unit, (i.e., detectors, logic control system and alarms). The warning system should be checked for failure alarm mode at least every shift. The system should be tested for operability immediately after maintenance is performed. Field observations should establish that the signal is audible above background level throughout all areas to be evacuated or that other signals, such as lights or beacons, provide operator warning.

g. Drills

The emergency response program should require that all personnel in the area to be evacuated be trained in evacuation methods and informed of routes and assembly stations. Provisions should be made for evacuation of transient personnel. All personnel should be involved in periodic (at least biennial) drills to maintain familiarity with the emergency procedures. Designated reentry teams should participate in periodic training reentry drills. These drills should be announced in advance.

The alarm system should be sounded periodically for employee familiarization with the alarms and to confirm that the alarms can be heard in all locations. All personnel in affected areas should be notified in advance of an audible test.

88020-04 RESOURCE ESTIMATE

An inspection performed using this inspection procedure is estimated to require 60 hours of inspector resources. This estimate is only for the direct inspection effort and does not include preparation for and documentation of the inspection.

88020-05 REFERENCES

U.S. Code of Federal Regulations, "Domestic Licensing of Special Nuclear Material", Part 70, Title 10, "Energy."

---"Standards for Protection Against Radiation," Part 20, Title 10, "Energy."

U.S. Nuclear Regulatory Commission, "Nuclear Criticality Safety in Operations with Fissionable Materials at Fuels and Materials Facilities," Regulatory Guide 3.4, Revision 2, Washington, DC, March 1986.

---"Nuclear Criticality Safety in the Storage of Fissile Materials," Regulatory Guide 3.43, Revision 1, April 1979.

---"Use of Borosilicate-Glass Raschig Rings as a Neutron Absorber in Solutions of Fissile Material," Regulatory Guide 3.1, Revision 2, September 1987.

---"Administrative Practices for Nuclear Criticality Safety at Fuels and Materials Facilities," Regulatory Guide 3.57, October 1986.

---"Criticality Safety for Handling, Storing, and Transporting LWR Fuel at Fuels and Materials Facilities," Regulatory Guide 3.58, October 1986.

---"Nuclear Criticality Safety Training," Regulatory Guide 3.68, April 1994.

American National Standards Institute/American Nuclear Society, ANSI/ANS-8.1-1983, "Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors," American Nuclear Society, La Grange Park, IL, October 7, 1983.

---ANSI/ANS-8.20-1991, "Nuclear Criticality Safety Training," American Nuclear Society, La Grange Park, IL, 1991.

---ANSI/ANS-8.21-1995, "Use of Fixed Neutron Absorbers in Nuclear Facilities Outside Reactors," American Nuclear Society, La Grange, IL.

---ANSI/ANS-8.19-1984, "Administrative Practices for Nuclear Criticality Safety," American Nuclear Society, La Grange Park, IL, October 1, 1984.

---ANSI/ANS-8.3-1986, "Criticality Accident Alarm System," American Nuclear Society, La Grange Park, IL, August 29, 1986.

---ANSI/ANS-8.5-1986, "Use of Borosilicate-Glass Raschig Rings as a Neutron Absorber in Solutions of Fissile Material," American Nuclear Society, La Grange Park, IL, January 3, 1986.

---ANSI/ANS-8.17-1984, "Criticality Safety Criteria for Handling, Storage, and Transportation of LWR Fuel Outside Reactors," American Nuclear Society, La Grange Park, IL, January 13, 1984.

---ANSI N16.5-1975/ANS-8.7, "Guide for Nuclear Criticality Safety in the Storage of Fissile Material," American Nuclear Society, La Grange Park, IL, April 12, 1975.

END