DRAFT JUNE 9, 2005 - INSPECTION PROCEDURE 8801Z

CRITICALITY ALARM SYSTEMS

PROGRAM APPLICABILITY: 2600

8801Z-01 INSPECTION OBJECTIVE

a. The regulatee establishes and maintains a criticality alarm system that will reliably detect the minimum criticality accident of concern in the monitored area and immediately cause an evacuation signal resulting in a prompt and complete evacuation of the facility.

8801Z-02 INSPECTION REQUIREMENTS

02.01 System Requirements

a. The regulatee's criticality accident alarm system must comply with all applicable NRC regulations and license commitments. The regulatee should maintain sufficient documentation to demonstrate that the system is capable, available and reliable to monitor all fissile material, detect the minimum accident of concern, and generate an adequate evacuation signal.

b. A complete description of the system, components, installation, logic, and response is available in the form of facility or vendor documentation. System design features include dual detector coverage of all areas, electronic logic requires that one detector be in the alarm mode before sounding the alarm, audio alarms and, as necessary due to noise levels, visual alarms are available, system surveillance is provided to warn of detector failure, and secondary emergency power is provided.

02.02 Audibility

a. The alarm signal annunciated in the facility is loud enough to cause an evacuation by all employees in the affected area but is not so loud as to cause hearing damage to employees close to the annunciator.

02.03 Response

a. Verify by observation, discussion, and document review that alarm set points are set to alarm when radiation levels exceed regulatory limits. Verify that access to the alarm set points is controlled to prevent inadvertent modification of the set points.

b. Alarm set points are set in accordance with written procedures to alarm when radiation levels exceed regulatory limits, access to the alarm set points is controlled by written procedures to prevent inadvertent modification of the set points, and the response of the

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detectors to a radiation field above the established threshold occurs quickly enough to cause evacuation before significant radiation exposure occurs.

02.04 Reliability

a. Verify by observation, discussion, and document review that system design features include dual detector coverage of all 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, visual alarms are available, that system surveillance is provided to warn of detector failure, and that secondary emergency power is provided.

02.05 Sensitivity

a. Fissile material areas or processes are covered by at least two detectors as demonstrated by sufficiently bounding and conservative assumptions and calculations. Evaluation demonstrates that the minimum accident of concern in the most conservative location will result in a radiation field at the detector sufficient to exceed the detector threshold.

8801Z-03 INSPECTION GUIDANCE

03.01 System Requirements

a. Criticality alarm systems shall be capable of a detecting a criticality producing an absorbed dose in soft tissue of 20 rads of combined neutron and gamma radiation at an unshielded distance of two meters from the reacting material within one minute.

b. Coverage of all areas shall be by two detectors.

c. A criticality monitoring system shall be maintained in all areas where special nuclear materials is handled, used or stored except at the Gaseous Diffusion Plants where a criticality monitoring system must be maintained in all areas of the facility.

d. The facility must maintain emergency procedures for each area in which SNM is handled, used, or stored to ensure that all personnel withdraw to an area of safety upon the sounding of the alarm.

03.02 Audibility

a. The alarm system shall be for immediate evacuation purposes only and of sufficient volume and coverage to be heard in all areas that are to be evacuated.

b. A sufficient number of signal generators shall be installed to provide complete facility coverage with an appropriate evacuation signal.

c. The evacuation signal shall be a mid-frequency complex sound wave that may be amplitude modulated at a subsonic frequency. The fundamental frequency shall not exceed 1000Hz. Modulation should be at a rate less than 5Hz.

d. The audio generators should produce an overall sound pressure level of at least 75dB, but not less than 10dB above the maximum ambient noise level typical of each area for which audio coverage is to be provided.

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e. Because excessive noise levels can be injurious to personnel, the audio generators should not produce an A-weighted sound level in excess of 115dB at the ear of an individual.

f. The signal generating system(s) shall be automatically actuated by an initiating event without requiring human action.

g. After actuation, the signal generators shall continue to function as required by emergency procedures, even if the radiation falls below the alarm point. Manual resets with limited access, should be provided outside areas that require evacuation.

h. Areas with very high audio background may require that the alarm be supplemented with visual signals.

03.03 Response

a. Evacuation shall be signaled promptly upon detection of an accident.

b. The alarm trip point should be set high enough to minimize the probability of an alarm from sources other than criticality. The level shall be set low enough to detect the minimum accident of concern. Detectors shall alarm when subjected to at least 10 rad/hr.

c. The system shall be designed to produce the criticality alarm signal within one-half second of activation by the minimum accident of concern.

d. The location and spacing of detectors should be chosen to avoid the effect of shielding by massive equipment or materials. Shielding from low density materials or construction, such as wood framing, thin interior walls, hollow brick tiles, etc., may be disregarded. The spacing of detectors shall be consistent with the selected alarm trip point and with the detection criterion.

e. Consideration shall be given to the avoidance of false alarms. This may be accomplished by providing reliable single detector channels or by requiring concurrent response of two or more detectors to initiate the alarm.

f. In redundant systems, failure of any single channel shall not prevent compliance with the detection criterion specified above.

g. The system shall not produce an evacuation signal due to component failure: however, a visible or audible signal shall be provided at some normally occupied location to indicate system malfunction or loss of primary power.

h. A means for manual actuation of the criticality alarm signal may be provided.

03.04 Reliability

a. The system shall be designed for high reliability and should utilize components that do not require frequent servicing, such as lubrication or cleaning.

b. The system should be designed to minimize the effects of non-use, deterioration, power surges, and other adverse conditions.

c. The design of the system should be as simple as is consistent with the objectives of ensuring reliable actuation of the criticality alarm signal and avoidance of false alarms.

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d. Process areas in which activities will continue during power outages shall have emergency power supplies for alarm systems, or such activities shall be monitored continuously with portable instruments.

e. All components of the system should be located or protected to minimize damage in case of fire, explosion, corrosive atmosphere, or other extreme conditions.

f. Design and installation of the system shall be such as to resist earthquake damage. The system should remain operational in the event of a seismic shock equivalent to the site design basis earthquake, or the equivalent value specified in the Uniform Building Code.

03.05 Sensitivity

a. Criticality alarm systems are designed to respond immediately to the minimum accident of concern. For this purpose, in areas where material is handled or processed with only nominal shielding, the minimum accident may be assumed to deliver the equivalent of an absorbed dose in free air of 20 rad at 2 meters from the reacting material within 60 seconds. The alarm signal shall activate promptly when the dose rate at the detectors equals or exceeds a value equivalent to 20 rad/min at 2 m from the reacting material.

b. In the design of radiation detectors it may be assumed that the minimum duration of the radiation transient is 1 ms. Systems shall be designed so that the instrument response and alarm latching shall occur as a result of transients of 1 ms duration.

c. To minimize false alarms, the trip point may be set in the rad/h range as long as the transient duration criterion is met. The alarm trip point of a rate sensing device should be more than 10 mrad/h above normal or operational background at the monitoring point.

8801Z-04 RESOURCE ESTIMATE

An inspection performed using this inspection procedure is estimated to require 8 hours of inspector resources for Category 1 facilities, 8 hours of inspector resources for Gaseous Diffusion Plants, 4 hours of inspector resources for Category 3 facilities, and 0.5 hours for small critical mass or fuel cycle facilities. This estimate is only for the direct inspection effort and does not include preparation for and documentation of the inspection.

8801Z-05 REFERENCES

U.S. Code of Federal Regulations, "Domestic Licensing of Special Nuclear Material," Part 70, Title 10, "Energy." §70.24, Criticality Accident Requirements

---"Certification of Gaseous Diffusion Plants," Part 76, Title 10, "Energy." §76.89, Criticality Accident Requirements

U.S. Nuclear Regulatory Commission, “Criticality Accident Alarm Systems,” Regulatory Guide 8.12, October 1988 (withdrawn)

American National Standards Institute/American Nuclear Society (ANSI/ANS)-8.1-1998, "Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors," American Nuclear Society, La Grange Park, IL, 1998.

---ANSI/ANS-8.3-1997, "Criticality Accident Alarm System," American Nuclear Society, La Grange Park, IL, August 29, 1997.

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