ANS Issues Clarification on ANSI/ANS-8.3-1986, "Criticality Accident Alarm System."
(*Nuclear New*, January 1996)

Inquiry 1:

"Why does Paragraph 4.2.2 specify *absorbed dose in free air*? The apparent intent of this paragraph is to determine where criticality accident systems (CASs) are needed based on potential radiation levels. If the concern is life threatening radiation doses, the phrases *absorbed dose in human tissue or whole body absorbed dose* seem to be more appropriate. The phrase *absorbed dose in free air* is more applicable to the radiation level that a detector would experience, which is appropriate for detector sensitivity calculations (Paragraph 5.6)."

Response 1:

The primary intent of the standard is to address required criticality alarm characteristics. The criterion of Paragraph 4.2.2 was therefore intentionally written in terms of detector capability, although as correctly noted, the overall goal is to provide personnel protection.

Also, the criterion of Paragraph 4.2.2 is stated to indicate that the issue of whether an alarm system is needed is segregated from the issue as to what the currently accepted conversion factors are for flux to biological dose conversion.

> 4.2.2 A criticality alarm system is not required by this standard in areas where the maximum foreseeable absorbed dose in free air will not exceed 12 rad. For the purpose of this evaluation, a maximum yield may be assumed not to exceed 2×10^{19} fissions for events outside the reactor cores.

Inquiry 2:

"Do the decibel requirements of Paragraphs 4.4.3 and 4.4.4 apply to individual signal generators or to the combination of all evacuation alarms that could be activated by detection of a criticality excursion and which could be heard in an area? For example, if a CAS activates both local and plant-wide evacuation signals, do the 75-dB minimum and 115-dB maximum limits apply to two signals together or to each signal separately? Similarly, if an area is covered by CASs and other radiation alarms, do the decibel requirements apply to the combination of the alarms or just to the CAS evacuation alarm?"

Response 2:

The recommendations of Paragraphs 4.4.3 and 4.4.4 apply to the sound level at an individual's ears. The source may be an individual signal generator or a combination of signal generators. The intent of these recommendations is to minimize personnel risk.

> 4.4.3 The signal generator should produce an overall sound pressure level which is not less than 10 dB above the overall maximum typical ambient noise level, and in any case not less than 75 dB (referenced to 20 $\mu N/m^2$) at every location from which immediate evacuation is deemed essential.
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> 4.4.4 Since excessive noise levels can be injurious to personnel, the signal generator should not produce an A-weighted sound level in excess of 115 dB (referenced to 20 $\mu N/m^2$) at the ear of an individual.

Inquiry 3:

"What are the applicable requirements for activities when a CAS is available or operable? Section 4.5 of the standard specifies requirements for dependability. However, the only guidance for alternatives to implement when CASs are unavailable or inoperable is specified for power outages (Paragraph 4.5.3). The power outage alternatives are:

a. Supply emergency power,
b. Discontinue activities in process areas, or
c. Continuously monitor the activities with portable instruments.

Is the omission of generic guidance intended to imply that the standard requires fully redundant CASs for each area or operation that needs a CAS to insure that, with the exception of power outages, at least one CAS is always available and operable? Or does the inclusion of alternatives for power outages imply that discontinuing activities or using portable instruments are acceptable alternatives when the primary CAS is unavailable or inoperable for other reasons (for example, calibration, maintenance, repair, or testing)?"

Response 3:

There are no specific applicable requirements for activities where a CAS is temporarily unavailable or inoperable, except for the case of a general power outage. It is the intent of the standard that alarm system unavailability due to any cause by minimized by both system design and maintenance procedures.

Specific standard requirements should not be inferred due to omission of specific guidance. By not providing guidance in regard to temporary alarm system unavailability, latitude is afforded as to the best course of action to be taken. It is reasonable that individual facilities have plans available for such occurrences, but specific requirements are beyond the guidance provided in the standard.

> 4.5.3 Process areas in which activities will continue during a power outage shall have emergency power supplies for alarm systems or such activities shall be monitored continuously with portable instruments.

Inquiry 4:

"Does the standard require that portable (for example, hand carried) CASs be seismically qualified? Although Paragraph 4.5.3 indicates that portable instruments are acceptable in some cases, Paragraph 5.3 requires that CASs *resist earthquake damage*. We assume that, if non-seismically qualified instruments are permitted, appropriate administrative controls are required to prevent using such an instrument during or after an earthquake until the instrument's operability is assured."

Response 4:

The standard does not require that portability instruments used to augment a criticality alarm system be seismically qualified.

> 5.3 Seismic Tolerance. The design and installation of the system shall be such as to resist earthquake damage. The system should remain operational in the event of seismic shock equivalent to the site-specific design basis earthquake, or the equivalent value specified by the Uniform Building Code.

Inquiry 5:

"Why does Paragraph 5.71 require that CASs respond to a 1 millisecond (ms) pulse regardless of the type of criticality accidents credible for the activities being monitored? If a CAS responds to all credible pulses and a short pulse is shown to be incredible, is the CAS acceptable if it does not respond to the 1-ms pulse?"

Response 5:

No; it does not meet this criterion. One of the purposes of the standard is to reduce the total risk to personnel by installation of a criticality accident alarm system in those cases where an alarm system can serve that purpose. For a single-pulse criticality, evacuation might help avoid additional personnel dose due to residual fission product activity.

The standard identifies specific technical requirements intended to address a wide range of facilities, each of which might be expected to have a range of potential criticality accident scenarios. Given detailed analysis of a specific facility, it might be reasonably concluded that, although one or more specific requirements of the standard are not met, the overall criterion of the standard is satisfied. Such a conclusion is a facility prerogative.

> 4.7.1 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 instrument response and alarm latching shall occur as a result of transients of 1 ms duration.

Inquiry 6:

"Does the standard require a CAS if the only credible criticality accident for the operation is a single, very short duration pulse? Assuming typical human reaction times, evacuation will not save lives or reduce exposures if the excursion lasts less than a second, the energy of the excursion disperses the critical configuration of the fissionable material, and the fissionable material cannot reassemble into a critical configuration."

Response 6:

Yes; one of the purposes of the standard is to reduce the total risk to personnel by installation of a criticality accident alarm system in those cases where an alarm system can serve that purpose. For a single-pulse criticality, evacuation might help avoid additional personnel dose due to residual fission product activity.

The standard identifies specific technical requirements intended to address a wide range of facilities, each of which might be expected to have a range of potential criticality accident scenarios. Given detailed analysis of a specific facility, it might be reasonably concluded that, although one or more specific requirements of the standard are not met, the overall criterion of the standard is satisfied. Such a conclusion is a facility prerogative.