Some Considerations for use of Alarming Personal Criticality Detectors

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Introduction

Criticality Accident Alarm Systems (CAAS), are used to alert personnel in affected areas (12 rad zone) to a criticality accident so that appropriate protective measures can be taken to limit their exposure to radiation.[1] Permanent CAAS installations are used to provide coverage for site areas that are within the 12 rad zone of potential criticality accident locations.

Discussion

ANSI/ANS-8.3-1997, para. 4.4.2[2] states:

> Portable instruments may be used in special situations to augment an installed criticality accident alarm system.
>
> Where portable instruments are used to meet the intent of this standard, the usage shall be evaluated to determine appropriate criteria of this standard.

This report specifically deals with Savannah River Site (SRS) augmentation of permanent CAAS systems by the use of portable instruments in areas not normally occupied by personnel.[3] That is, in areas defined as "not normally occupied", a portable instrument could be used instead of expanding the permanent CAAS system into the area not normally occupied. The term "portable instrument is considered to include alarming personal criticality detector instruments worn on the protected workers person, and containing sufficient audible volume, or supplemented with vibrators or earpieces.

This presentation discusses

- Establishing the technical basis and minimum requirements for Alarming Personal Criticality Detectors (APCD) to be defined as "portable instruments" (as used in ANSI/ANS-8.3-1997) to augment permanent CAAS installations in facility areas not normally occupied;
- Defining the term "not normally occupied":
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- Providing specific APCD design criteria and document how specific APCDs meet the criteria;
- Providing administrative requirements for APCD usage

Defining "not normally occupied"

Not Normally Occupied – An area for which entry is controlled and recommended occupancy is limited to 168 hours per year, not to exceed 40 hours per month, and the number of occupants is limited to 10 at any given time.[4] Facility management may request an extension of occupancy time and/or number of occupants, subject to local Criticality Safety Committee concurrence

APCD Design Criteria

1. APCDs shall resist radiofrequency interference
2. APCDs shall be capable of alarming on cumulative dose
3. APCDs shall provide an audible signal that is recognized as requiring prompt evacuation.
4. Documented test results shall demonstrate prompt and automatic APCD alarm response to a simulated criticality accident, capability to alarm in radiation fields typical of a criticality accident, and that the APCDs produce an alarm when exposed to a short duration radiation transient (approx. 1 msec)
5. APCDs shall provide a signal that is sufficiently long to get their attention.
6. APCD audio alarm shall be loud enough to be heard by the individual wearing the device
7. APCD audio alarm sound level should not be loud enough to cause hearing damage.
8. APCDs should include the ability to use earpieces or provide vibration alarms.
9. APCDs shall be capable of alerting the user to a low battery condition.
10. APCDs should not require frequent servicing, lubrication, or cleaning.
11. APCD design should minimize effects of non-use, deterioration, and other conditions (e.g., RF interference).
12. APCD design should be a simple as is consistent with the objectives of ensuring actuation of the criticality alarm and avoidance of false alarms.

13. APCDs should be designed to minimize the potential for failure, including deactivation and false alarms, due to human error.
14. APCDs shall provide an indication of system malfunction, including low battery condition

Administrative Requirements for APCD Use

1. APCD cumulative dose alarm shall be set high enough to avoid false alarms while retaining the capability to detect unsafe dose to workers.
2. APCD alarm setpoints should be set sufficiently above background to minimize false alarms.
3. Facilities/projects using APCDs shall have an approved training program/procedure on APCD use, Including response to low battery condition or device malfunction, available functions, and actions to avoid false alarms and including visitors
4. If protective actions other than evacuation are necessary, they shall also be specified in training.
5. Personnel shall be capable of distinguishing the APCD alarm from other alarms.
6. Personnel shall be trained and have a means to contact the appropriate control room after evacuation so that the event is logged and other facility emergency actions can be taken as necessary.
7. When using APCDs in high noise areas, the APCDs shall be equipped with earpieces and/or vibration alarms.
8. APCD pre-alarms, if provided, should be disabled.
9. A minimum offset distance from the edge of a designated potential criticality accident location (e.g., edge of tank) shall be established to ensure APCD functionality, based on instrument testing.
10. APCDs must respond to a step increase in radiation in a time frame similar to that of regular CAAS instruments in the annual CAAS response test.
11. An APCD shall be calibrated and tested prior to being returned to service following any modifications, repairs or events that call APCD performance into question. It shall not be re-used after exposure to excessive radiation fields.
12. APCDs shall be periodically tested to ensure continued instrument response to radiation, monthly unless historical data suggests that less frequent testing is sufficient..
13. APCDs with self-checking features (if available) shall be tested periodically in conjunction with other testing.
14. APCDs shall be tested at least annually to ensure that the audible alarm is functional.
15. If an APCD fails any test, recalibration, or if a system fault is received, then it shall not be used until corrective action has been completed and the APCD has passed all necessary tests.
16. The records of tests, calibrations and maintenance for each APCD shall be maintained
17. Upon exiting area not normally occupied, regular facility CAAS evacuation routes shall be followed.

Results

Bases for the selection and use of alarming personal criticality detectors for specific application to areas not normally occupied were established at SRS consistent with ANSI/ANS-8.3-1997. Siemens EPD-Mk2 and EPD-N devices were qualified as meeting the design criteria.[4,5] Other instruments will be evaluated in the future. These design criteria and administrative requirements developed herein may be considered to guide such analyses at other sites, or adopted as written.

References

1. DOE Order 420.1A, Facility Safety, Att. 2, para. 4.3.2.e, U. S. Department of Energy, 5/20/2002.
2. ANSI/ANS-8.3-1997, Criticality Accident Alarm System, published by the American Nuclear Society, 5/28/1997.
3. N-TRT-G-00001, Technical Basis for the Use of Alarming Personal Criticality Detectors to Augment Permanent Nuclear Incident Monitor Systems in Areas Not Normally Occupied (U), K. R. Yates, Westinghouse Savannah River Company, 4/21/2003.
4. WSMS-SAE-M-03-0076, Modified NIM Protection for Areas that are Not Normally Occupied, A. A. Coutts, Washington Safety Management Solutions, 4/21/2003.
5. Evaluation of Siemens Environmental Systems Model Mk-2 Electronic Personal Dosimeter, T. E. Bratvold, Battelle Memorial Institute, July 2001.