Operational Assessments

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Self-Indicating Instant Radiation Alert Dosimeter (SIRAD) Test Results: Final Report

Print

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Standards Applied:

The overall objective of this campaign was to determine the applicability of the SIRAD for emergency responders in an urban environment. The campaign consisted of four components, listed here with their objectives.

A. Field deployment – investigate distribution and operational parameters, including the probability for false positives, loss, and misuse.
B. Laboratory irradiation – assess dosimetric response to photons, neutrons, and beta radiation in the context of existing standards for emergency dosimetry.
C. Visual readout – assess variations in visual interpretation of the color-dose scale using laboratory irradiated dosimeters.
D. Environmental tests – verify the manufacturer's specifications and test performance under potential end-user external stresses.

Each section of this report is organized into subsections A, B, C, and D for the four components of the campaign. Interim reports with preliminary results and additional details about each component have been posted at the CounterMeasures Test Beds (CMTB) Web site at https://eml.st.dhs.gov/CMTB/main.cfm.

The four components of the test were designed to provide overlapping information to test the following hypotheses:
• Is the SIRAD format usable by emergency responders without significant damage, loss, or interference with operations?
• In routine field deployment, does the SIRAD have a false positive probability of less than 1 percent?
• Are the SIRAD radiation response and calibration acceptable in the context of existing standards for other types of emergency dosimeters?
• Can the color scale on the SIRAD card be accurately interpreted visually?
• Are the manufacturer's specifications accurate?
• Does the card function under potential end-user environmental stresses?
• Is the SIRAD card appropriate for use by first responders for preparedness for potential radiological terrorist events?

Configuration Tested: The SIRAD met expectations for the field deployment. The test protocol underwent a full board review by the Human Subjects Institutional Review Board (IRB) at the Lawrence Livermore National Laboratory. The IRB required that we develop a consent form for each participant to sign, which clearly explained the risks and benefits of the study, before being issued the dosimeters. Participants were instructed to carry the cards for nine months, such that they would not interfere with routine duties, for example, along with ID cards already in use on existing badge clips, on lanyards, or in ID cases. We provided optional safety lanyards and badge clips.

The participants carried the SIRAD during duty hours with the option to also carry them while off duty. Most of the targeted participants are not routinely occupationally exposed to radiation and were not expected to receive an occupational radiation dose measurable by the SIRAD cards during the field test. Therefore, thermoluminescent dosimeters (TLD) were attached to the fielddeployed SIRADs to confirm any SIRAD positive readings. The POC was given pre-addressed mailers to send the TLDs for emergency processing, if needed. The backup TLD would be read only in the case of a SIRAD color change to verify a radiation dose or identify a false positive; the campaign was not looking for false negatives in the field test. Participants were instructed to call a toll-free number printed on the front of the SIRAD if there was a color change. The number connected to a Reachback program maintained specifically for the SIRAD project with EML staff scientists available 24/7 to provide guidance to participants on sending the backup dosimeter for processing and appropriate actions to take until the TLD results are received.

Description: Problem statement
The Self-indicating Instant Radiation Alert Dosimeter (SIRAD) campaign investigated the suitability of a credit-card format, human-readable radiation dosimeter as a dose control tool for preparedness and response to a terrorist event involving radioactive material. The device could fill a technology gap for first responders since they do not routinely carry radiation dosimetry. The SIRAD is a passive, disposable dosimeter that changes color upon exposure to a medically
significant radiation dose. Its convenient format and low cost ($10-20) would allow for predistribution and provide immediate indication of any significant radiation exposure. This would provide reduced responder anxiety and response delays when exposure is low, and support for tactical response decisions when exposure is high.

Deployed description
The SIRAD model tested has a color matching scale indicating doses from 5-200 rad. In the field test component of this campaign SIRADs were distributed to emergency responders in New Jersey, New York, and Illinois, along with a back-up thermoluminescent dosimeter (TLD) for dose verification and a 24-hour hotline for assistance in case of a color change. Regulations for human subjects research were followed. Other components of the campaign assessed the response of SIRAD to laboratory irradiations and physical stresses and investigated variations in visual interpretations of the color scale. Results were evaluated in terms of personnel dosimetry consensus standards, ANSI N13.11 and N322, which provide a general framework to quantify performance, though not written for SIRAD and not a pre-requisite for its use.

Key outcomes
The overall outcome is that the SIRAD demonstrated generally acceptable performance for homeland security mission needs. Incidence of loss or damage to the device during field deployment was low, false positive rates were less than one percent, and field conditions and physical stresses did not seem to compromise performance. The response to laboratory controlled irradiations was acceptable: SIRAD passed one out of three of the ANSI N13.11 accident categories (category IC, photons of low energy, 73 keV) and showed a 30 percent positive bias to 662 keV photons, thus tending to err on the side of caution. It responded to electrons but showed negligible neutron response. Visual interpretation of the color reference scale was variable but appears adequate for tactical applications in identifying high doses compared to a response worker guideline.

Decisions that can be made
Using these results, local responder decision makers can decide if SIRAD is a suitable dose control tool for their departments. DHS policy makers can decide on inclusion of SIRAD in new standards and other DHS resources, such as the System Assessment and Validation for Emergency Responders (SAVER) program.

Knowledge Links

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