Position Paper – Dosimetry and OSL Technology in Emergency Response

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I. Introduction.

The purpose of this paper is to address the use of dosimetry by first responders during a radiological incident and the maintenance of dosimetry documentation and the "legal dose of record" for response personnel. And to discuss optically stimulated luminescence (OSL) technology and its applications in emergency response. I have based my recommendations on 10 CFR, Part 20, Subpart C (Nuclear Regulatory Commission) and guidelines published by the Environmental Protection Agency (EPA).

Since 2001, as I have conducted radiological training programs, I have witnessed an exponential increase in responder knowledge on the subject of radiological response. However, while continual air monitoring is second nature to responders in chemical response, I have observed insufficient resources and procedures for dosimetry during radiological response. And although record keeping for chemical exposures by responders is an extensive component of their annual physical evaluations, dosimetry documentation continues to elude most first responder organizations.

In my opinion, the use of the term "occupationally" should apply to both career and volunteer responders in radiological response, as "maximum permissible doses" established by the EPA do not discriminate between career and volunteer personnel. And while I feel it is important to set guidelines for emergency response that are scientifically based, it is my belief that all responders should at all times practice the principal of ALARA to keep doses "As Low As Reasonably Achievable".

II. Summary of 10 CFR, Part 20, Subpart C

According to 10 CFR, Part 20, Subpart C, anyone likely to receive a dose in excess of 10 percent of the dose limit must be monitored. The yearly dose limit for occupational workers is 5 rem. Ten percent of that yearly occupational dose limit is 500 mrem. Therefore, according to 10 CFR, Part 20, Subpart C, anyone likely to receive a dose in excess of 500 mrem must be monitored. The current EPA single incident guidelines for emergency workers (as listed in the next paragraph) well exceed this dose. Therefore, by definition, emergency workers must also be monitored.

III. Guidance on Dose Limits for Workers Performing Emergency Services

A. 5 rem – All activities.

B. 10 rem – Protection of valuable property (infrastructure) when a "lower dose is not practicable".

C. 25 rem – Life saving or protection of large populations when a "lower dose is not practicable".

D. > 25 rem – Life saving or protection of large populations "only on a voluntary basis to persons fully aware of the risks involved".

IV. "Legal Dose of Record"

A "legal dose of record" is a necessary document for response teams, not just from a liability or litigation perspective, but I feel it is also an ethical responsibility with respect to the health and safety of the team's personnel. As far as dosimetry documentation, there are two requirements that must be meant for that documentation to be considered the "legal dose of record". The first requirement is that the dosimetry device must be passive; that it not be capable of being erased or zeroed by the wearer. The second is that the dosimetry results must be analyzed by an accredited laboratory. In the United States, the lab performing the analysis must be accredited by either the National Voluntary Lab Accreditation Program (NVLAP) or the Department of Energy Lab Accreditation Program (DOELAP). While "active" self-reading detection and dosimetry devices with alarm capability are a must to provide responders with an immediate measurement of their environment, these instruments do not fulfill the requirements of "legal dose of record". Therefore they must be supplemented with passive dosimetry, which meets these requirements.

V. Optically Stimulated Luminescence Technology & First Responder Applications

Optically Stimulated Luminescence (OSL) dosimetry devices contain radiation-sensitive aluminum oxide. When atoms in the aluminum oxide are exposed to radiation, electrons are trapped in an excited state until irradiated with a specific wavelength of light. The released energy of excitation, which is given off as visible light, is measured to determine radiation dose. OSL technology was developed in 1992 and today approximately 1.5 million personnel in various industries throughout the world utilize OSL dosimeters.

There are two factors of OSL technology which offer benefits for the first responder community. First, unlike thermoluminescent dosimetry (TLD) technology, OSL analysis is non-destructive. Therefore, reanalysis can be performed for dose verification. Second, OSL dosimetry reader technology is now portable, enabling responders to actually be able to obtain passive dosimeter readings on scene. And the cost of these systems is relatively inexpensive when compared to other technologies utilized for WMD and hazardous materials response.

OSL technology applications for first responders are not limited to dosimetry. Another application is for use in environmental background studies which are necessary in order to establish effective decontamination protocols for a radiological event. The EPA defines radiological contamination as being 2 to 3 times normal background. Therefore, by definition, decontamination would be achieved (or decontamination would not be required) when detector readings are below 2 times normal background. But what is normal background? A background study can easily be conducted by placing OSL dosimeters throughout a response area for a period of time. This type of study requires far less personnel time and effort than that of conducting a background study utilizing daily detector readings. And a background study conducted with the use of dosimeters provides a more accurate background measurement because the dosimeters are exposed during the entire time of the study. Detector readings provide only “snapshots” of the background measurement during the time of the study.

VI. Summary

In my opinion, according to 10 CFR, Part 20, Subpart C, dosimetry is not an option for first responders, it's a requirement. In addition, the maintenance of dosimetry documentation and the "legal dose of record" for response personnel is not just a liability or litigation issue, it is a health and safety issue. And yet dosimetry documentation continues to elude most first responder organizations. It is also my opinion that with the advances in OSL dosimeters and dosimetry readers, OSL, like FTIR and Raman technologies, is now a practical and economical technology for use in the first responder arena. Finally, as I stated in the introduction, it is my belief that all responders should at all times practice the principal of ALARA.

Bibliography

1. 10 CFR, Part 20, Subpart C
   Nuclear Regulatory Commission, 1991

2. Manual of Protective Action Guides and Protective Actions for Nuclear Incidents
   United States Environmental Protection Agency, 1992

3. **"**Using & Wearing Radiation Monitoring Badges"
   Princeton University Environmental Health & Safety, 2009

4. "Active and Passive Dosimetry"
   Robert H. Rachford, Landauer, Inc., 2007