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#08-68 1D OSL/FO dosimeter array for remote radiological investigations in hard-to-access zones

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Introduction

Remote dosimetry (RD) is an essential tool for Decommissioning and Dismantling (D&D) as it enables to predict the impact of decontamination procedures in terms of worker exposition and to set up a cost-effective dismantling scenario associated with a risk analysis and waste management strategy. However, long-range RD in hard-to-access zones (e.g. tanks, reactors, storage ponds etc.) is still challenging. A critical case concerns inspections through small-diameter pipes (< 1 cm) of small radius of curvature that require miniaturized dosimeters. The miniaturization of conventional active dosimeters leads to a reduction in detection volume that in turn degrades the limit of detection (LOD) in dose rate. Furthermore, miniaturization is limited by electromagnetic (EM) shielding and embedded electronics (power supply, signal conditioning, thermal regulation) and signal degradation arises due to cable length as well. Geiger-Mueller detectors are often used to this purpose but they are still too bulky and fragile and require a modeling to retrieve dose rate from counting data.

During the past 20 years, CEA investigated an alternative RD technique based on OSL/FO probes (Optically Stimulated Luminescence/Fiber Optics), affixed at the extremity of armored optical cables, robust enough to be pushed and removed within pipes. OSL/FO is a passive online dosimetry technique which does not require local electronics to operate (the readout unit is out of radiological zone). The LOD may be as low as several µGy/h (for daylong integration times), therefore making OSL/FO useful for the assessment of cleaning processes for instance. This technique provides wide range in dose rate detection (6 decades) by a suitable combination of integration time and dose. Other main advantages are EM and Cerenkov immunities, long-range remote operation, high miniaturization (sensor head Ø = 5 mm), high radiation resistance and very low fading (the OSL signal changes linearly with the integration time at constant dose rate). Finally, OSL/FO sensors are waterproof and easy to decontaminate.

The INSPECT Project

The INSPECT project started 11/2016 for 54 months. It aims at developing two multichannel OSL/FO readout units, a human-machine interface, and innovative 1D OSL/FO detectors (10- and 16-point detectors) for the monitoring of dose rate profiles within the range [µGy/h –Gy/h]. They are connected to a readout unit through a MIL-38999 hybrid (electrical + FO) connector which also incorporates an EEPROM for immediate data transfer of manufacturing and calibration data. Finally, field tests are planned on several French pilot sites (Orano La Hague, CEA Marcoule, CEA Cadarache).

Conclusion

OSL/FO dosimetry provides radiological investigations in hard-to-access zones in the range [µGy/h - Gy/h]. It is now a proven RD technique for D&D, sparing heavy duty that would otherwise be necessary to provide access to conventional dosimetric means. Dose rate data coupled with topographic modeling of the inner infrastructure enable activity reconstructions with the help of Monte-Carlo modeling. The use of 1D detectors speeds up the investigation process and improves localization uncertainty in comparison with point dosimeters (0D). A performance assessment of the INSPECT device will be presented during the conference.

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